

THE GENUS *CULEX*, SUBGENUS *EUMELANOMYIA*
THEOBALD IN SOUTHEAST ASIA AND
ADJACENT AREAS¹

By

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INTRODUCTION

The subgenus *Eumelanomyia*, as currently interpreted by Sirivanakarn (1971) in his proposed reclassification of *Neoculex* includes practically all *Culex* species which were previously placed in the subgenus *Mochthogenes* and a number of species in the subgenus *Neoculex* according to the classification of Edwards (1932, 1941). The subgenus in the present sense is one of the largest in *Culex* with distribution largely restricted to the Ethiopian and Oriental regions. The most up to date records from the literature (Stone, Knight and Starcke 1959; Stone 1967, 1970) include approximately 66 nominal species of which 37 are from the Ethiopian region, 27 from the Oriental region, 1 from the Papaun part of the Australasian region and 1 from the South Pacific. For a list of the majority of species currently assigned to *Eumelanomyia*, see Sirivanakarn (loc. cit.).

In the Oriental region, the subgenus is predominantly Indomalayan with an extension to the west as far as India and Ceylon, to the north and northeast as far as China, Ryukyu Islands, Japan and Korea and to the east as far as New Guinea. All of the nominal species described prior to the present work were treated either as *Neoculex* or *Mochthogenes* under which only a small number was locally revised. Among these, the major studies are: Barraud (1934: 347-359) who treated 7 species (2 under *Neoculex*, 5 under *Mochthogenes*) from India, Burma and Ceylon; Delfinado (1966: 124-135) who treated 8 species (2 under *Neoculex*, 6 under *Mochthogenes*) from the Philippines and Bram (1967: 23-42) who treated 5 species (2 under *Neoculex*, 3 under *Mochthogenes*) from Thailand. Among the short papers, dealing primarily with the descriptions of species are: Edwards (1923, 1930), Bohart (1953), Bohart and Ingram (1946), Carter and Wijesundara (1948), Chu (1957), Wattal, Kalra and Krishnan (1966), Lien (1968), Klein and Sirivanakarn (1969) and Klein (1970). Nearly all of the species reported from the areas are known primarily as males; the females are still obscure or unknown and the immature stages are very incompletely known. The earlier distribution records of most species are extremely incomplete and often unreliable and no attempt prior to Sirivanakarn (1971) had been made to determine the affinities of all the various taxa involved.

Following the scheme of reclassification of *Neoculex* currently proposed by Sirivanakarn (loc. cit.), the present study is a revision of the *Eumelanomyia* from Southeast Asia. The species which are known only from adjacent areas, such as India and Ceylon are also included in this revision for comparative purposes and for characterizing the whole Oriental fauna. The emphasis in

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this attempt is to diagnose, describe and illustrate all available stages as well as to determine the affinities and to provide more complete distribution records of all species within the areas. In this paper, 27 *Eumelanomyia* species are recognized and of these, 3 are new and 24 are revalidated and redescribed. Five of the previously named forms are considered here as synonyms. These are: *chiyuloi* Baisas and *shrivastavii* Wattal, Kalra and Krishnan as synonyms of *foliatus* Brug; *culionicus* Delfinado as a synonym of *hinglungensis* Chu; *tricontus* Delfinado as a synonym of *cataractarum* Edwards and *lini* Lien as a synonym of *okinawae* Bohart.

The material upon which this study has been based consists of numerous field caught and reared specimens accumulated at the Southeast Asia Mosquito Project and at the U. S. National Museum. These specimens were obtained from the collections by the U. S. Army Medical Component, SEATO laboratory in Thailand; by J. M. Klein of ORSTOM in Cambodia; by personnel of the U. S. Army Medical unit in Vietnam; by S. Ramalingam's team of collectors, Department of Parasitology, University of Malaysia, Kuala Lumpur in Malaya and Singapore; by W. V. King, L. E. Rozeboom, K. L. Knight, J. Laffoon, E. S. Ross, F. E. Baisas, M. Delfinado, G. Alcasid and others in the Philippines, and by the U. S. Army Medical unit in the Ryukyu Islands. Additional specimens include the institutional loans and the loans from private collections made to the Southeast Asia Mosquito Project (SEAMP) by J. C. Lien in Taiwan; Chicago Museum; California Academy of Science; Philadelphia Academy of Science; Instituut Voor Tropische Hygiene, Amsterdam; Institute of Medical Research in Kuala Lumpur, Malaysia, and British Museum, London.

The methods of presentation, terminology and abbreviations used in the descriptions of adults in general follow Bram (1967) except for some terms recently introduced by Knight (1970a, b), namely: ocular line to replace orbital line, pedicel to replace torus, labial basal setae to replace basal bristles and cibarial armature to replace buccopharyngeal armature. The pupal and larval terminology follows Belkin (1962). All abbreviations of the names of institutions where the type specimens are deposited follow Stone, Knight and Starcke (1959).

In listing the specimens under "Distribution", only the names of countries, provinces (if known) and localities and number of specimens examined are given. The full data on these specimens are placed on file at the Southeast Asia Mosquito Project and is available on demand to those interested.

TAXONOMIC HISTORY

The history of *Eumelanomyia*, currently accepted as a valid subgeneric taxon with two synonyms, namely, *Protomelanoconion* and *Mochthogenes* (Sirivanakarn 1971) is briefly summarized below.

Eumelanomyia was originally recognized as a distinct genus by Theobald (1909, 1910) with *Eumelanomyia inconspicua* from the Ethiopian region as the type species. This genus was described as being similar to *Culiciomyia* but the true identity of the type species was not known until Edwards (1922a) re-examined the specimens and identified them as *Culex*. The name *inconspicua* was thus found to be preoccupied, was rejected and the new name *Culex albiventris* proposed by Edwards for this species. In 1910, Theobald recognized *Protomelanoconion* as a distinct genus based on a misidentified *Culex* species which he named *Protomelanoconion fusca*. Edwards (1922a) again found this name to be preoccupied and therefore proposed the name *Culex horridus* to replace it. In addition to these corrections, an attempt was made by Edwards (loc. cit.) to group a number of *Culex* species with the suggestion that both *Eumelanomyia* and *Protomelanoconion* be treated as separate subgenera of *Culex*. However, since only a few forms representing these group taxa were known, no further progress was made by Edwards in their taxonomy during that period. Later in 1930, Edwards recognized *Mochthogenes* as a subgenus of *Culex* to include only the old world species with male palpus as short as in the female. The type species of *Mochthogenes* was *Culex malayi* which was

erroneously described as *Aedes malayi* by Leicester (1908). No significant contribution was made towards a better understanding of the taxonomy of these 3 nominal group taxa until 1932 when Edwards classified and characterized all known *Culex* subgenera on a worldwide basis. In his treatment, *Eumelanomyia*, *Protomelanoconion* and 20 other *Culex* species were grouped within the subgenus *Neoculex* Dyar 1905. The subgenus *Mochthogenes* was retained although he apparently indicated that it comprised species which do not differ essentially from *Protomelanoconion*. The subgenus *Neoculex* was subdivided into 3 groups: A. *Neoculex* or *apicalis* group; B. *Eumelanomyia* or *albiventris* group and C. *Protomelanoconion* or *uniformis* group. Later, in his revision of the Ethiopian fauna, Edwards (1941), recognized 2 additional groups (*pulchrithorax* and *rima*) and changed group B (*Eumelanomyia*) and group C (*Protomelanoconion*) to groups D and E. Edwards' scheme though not entirely satisfactory as pointed out by Mattingly and Marks (1955) and Belkin (1962), lead to no significant changes until 1971 when the question was critically examined by Sirivanakarn who finally proposed a reclassification of all *Neoculex* and *Mochthogenes* species. In this new scheme, 3 subgenera were recognized, namely, *Neoculex*, *Maillotia* and *Eumelanomyia*; and the other 2 nominal group taxa: *Protomelanoconion* and *Mochthogenes* were synonymized with *Eumelanomyia*. For a more complete treatment of the various group taxa according to the new scheme, see Sirivanakarn (1971).

Genus *CULEX* LINNAEUS

Subgenus *EUMELANOMYIA* THEOBALD

- Eumelanomyia* Theobald 1909, Colon. Rep. Misc. Ser. No. 237: 10; 1910 Mon. Cul. 5: 240. TYPE SPECIES: *Culex albiventris* Edwards 1922a (nom. nov. for *Eumelanomyia inconspicua* Theobald 1909).
- Protomelanoconion* Theobald 1910, Mon. Cul. 5: 462. TYPE SPECIES: *Culex horridus* Edwards 1922a (nom. nov. for *Protomelanoconion fusca* Theobald 1910).
- Culex (Mochthogenes)*, Edwards 1930, Bull. ent. Res. 21: 305. TYPE SPECIES: *Culex malayi* (Leicester) 1908.
- Culex (Neoculex)* in part, Edwards 1932, in Wytzman, Genera Insect. fasc. 194: 193-194; 1941, Mosq. Ethiopian Region 3: 249-269; Barraud 1934, Fauna Brit. India, Diptera 5: 347-352; Delfinado 1966, Mem. Amer. Ent. Inst. 7: 124-128; Bram 1967, Contrib. Amer. Ent. Inst. 2: 23-32.
- Culex (Mochthogenes)*, Edwards 1932, in Wytzman, Genera Insect. fasc. 194: 195; 1941, Mosq. Ethiopian Region 3: 277-279; Barraud 1934, Fauna Brit. India, Diptera 5: 352-359; Delfinado 1966, Mem. Amer. Ent. Inst. 7: 128-135; Bram 1967, Contrib. Amer. Ent. Inst. 2: 33-42.

FEMALE. Small to medium sized, dark and unornamented species. *Head.* Decumbent scales on dorsum of vertex varied from narrow to broad; erect scales numerous, usually entirely dark; palpus and proboscis dark scaled; palpus 3 or 4-segmented, usually 0.2 of proboscis length, sometimes shorter, segments 1 and 2 not clearly marked, segment 3 slightly longer than segments 1 and 2 combined, segment 4 longest, equal to or slightly longer than the combined length of segments 1-3; labial basal setae 4 in number, length varied; flagellomeres 1-13 of antenna subequal in length, each with a weak whorl of 5-6 hairs which are 1.5-2 times as long as flagellomere following. *Cibarial armature.* Usually very well developed, number, texture and arrangement of teeth varied. *Thorax.* Integument of pronotum, scutum and scutellum dark brown; scutal and scutellar scales narrow and predominantly dark; acrostichal bristles usually present on anterior half of scutal disc, sometimes absent or only a few present; pleuron paler or as dark as scutum, scales completely absent or only a few present on upper corner and posterior border of *stb*; 1 lower *me* bristle usually present, sometimes absent. *Legs.* Coxal integument paler than or as dark as pleuron; fore and mid femora dark anteriorly and dorsally,

pale ventrally; anterior surface of hind femur usually with a white stripe extending from base to apex, rarely dark, dorsal surface dark, ventral surface pale; all tibiae and tarsi dark; all tarsal claws small, equal and simple; pulvilli poorly or well developed. *Wing*. Plume scales dark, usually narrow, sometimes broad oval; halter knob dark scaled, peduncle pale, without scales. *Abdomen*. Terga usually entirely dark scaled, sometimes with pale basal bands or basolateral pale spots on terga II-VII; sterna paler scaled or sometimes as in terga.

MALE. Generally similar to females except for sexual characters as in the following. *Head*. Palpus varied from 0.2 to longer than the proboscis, short palpus 3-4 segmented as in female, long palpus 5-segmented; proboscis with or without false joint; pedicel of antenna unmodified; flagellomeres 1-11 subequal in length, usually with 2 series of whorls, 1 of which is large (normal whorl), with 15-40 long hairs, the other small (minor whorl) with 4-15 short and weak hairs, sometimes with large normal whorls only; flagellomeres 12 and 13 elongate, subequal, about two times as long as flagellomere 11. *Legs*. Claws of fore and mid legs enlarged, unequal, external one larger than internal, each with a small basal denticle; claws of hind leg small, simple, as in female. *Terminalia*. Tergal lobes of segment IX usually small, sometimes large and prominent, setae varied in length and number; sternum IX broad, rectangular; without any scales or setae; basimere usually slender, conical, sometimes large and strongly modified, strong submarginal setae present or absent; subapical lobe usually small; proximal and distal divisions usually not clearly divided; proximal division with 3 rod-like setae; distal division with or without 1 strong basal seta and 1 leaflet laterally, and always with a variable number of hair-like or blade-like setae mesally; distimere usually slender, sickle-shaped, sometimes strongly modified; claw well developed, length and thickness varied, usually subapical, sometimes apical; ventral subapical seta usually present; dorsal one present or absent; phallosome oval or subspherical in shape, rarely modified, (upper) tergal bridge median or submedian in position, lateral plate narrow-broad oval or tapered towards apex, denticles varied in number and size, more or less restricted to upper tergal surface, sometimes also with a strong tooth-like internal process; ventral sternal lobe usually small, indistinct, rarely large or prominent; proctiger crown small to medium sized, number and texture of spicules varied, lateral paraproct usually thin, basal sternal process absent, cercal setae 2-4 in number.

PUPA. Abdomen 1.7-3.0 mm, paddle 0.4-0.52 mm, trumpet 0.36-0.52 mm, index 7-10. All ground pool forms generally pale or cream colored, those from treeholes yellowish brown to dark brown; trumpet darker than underlying integument, usually uniformly cylindrical, sometimes more or less elliptical, pinna with or without slit extending to meatus. *Cephalothorax* and *Metanotum*. Hair 8-C usually double, sometimes 3-4b; 9-C single or double; 10-C usually double, sometimes 4-5b; 11-C double, rarely single. *Abdomen*. Hair 5-IV 2-4b; 5-V, VI usually double (1-3); 9-VIII weakly plumose and placed near caudolateral angle. *Paddle*. Broad oval, usually very pale to almost transparent, distal external margin smooth, without fringe of spicules, midrib pale or lightly pigmented, apical hairs 1 present or absent; 2-P always present.

LARVA. Head 0.6-0.75 mm, siphon 0.9-3.0 mm, index 5-15, saddle 0.2-0.3 mm, siphon/saddle ratio 3-10. Pigmentation varied as in pupa. *Head*. Broader than long; antenna as long as head, spicules strong and numerous, hair 1-A strongly plumose, 2 and 3-A dark, strong, single, usually placed subapically, sometimes apical; mouth brushes filamentous; head hair 1-C a dark, stout spine; 5, 6-C varied in length, both hairs usually double, sometimes single or 3-4b; mental plate dark, with 1 large median tooth and 6-7 smaller lateral teeth on each side. *Thorax*. Unspiculated; hair 3-P short and weak, about 0.25 of hair 1 or 2-P, usually single; 4-P usually strongly reduced in length, its length varying from shorter than 3-P to as long as 1 or 2-P, 1-4b; 7-P 1-2b; 8-P subequal to 7-P, always single; 14-P always double. *Abdomen*. Without spicules; hairs 6-I, II double; 7-I usually single sometimes double;

6-III-V 2-4b, 6-VI 1-4b; comb scales numerous, usually undifferentiated in size; hair 2-VIII single. *Siphon*. Slender, moderately long to very long; pecten teeth 8-15 in number, graded size or strongly differentiated in length; siphonal tufts 4-6 pairs, placed ventrally or subventrally, their length varying from 1-5 times as long as siphonal width at point of attachment; median caudal filament of spiracular apparatus usually present in all ground pool forms, absent in treehole or bamboo forms. *Anal segment*. Hair 2-X 1-3b; ventral brush usually with 6 pairs of hairs, sometimes 5, all inserted within grid; anal gills as long as or longer than saddle.

DISTRIBUTION. *Eumelanomyia* is more or less restricted to the tropics of the Ethiopian and Oriental regions with a small extension to the east as far as the Papuan part of the Australasian region and the South Pacific. In Southeast Asia, it has been recorded mainly from Thailand, Cambodia, Vietnam, West Malaysia, the Ryukyu Islands and the Philippines. Very few species are known from East Malaysia and most parts of Indonesia no doubt largely due to the absence of collections from these areas.

SYSTEMATICS. Within Southeast Asia and adjacent areas, the adults and the immature stages of *Eumelanomyia* are distinguished from other subgenera of *Culex* by the combination of the following characters. The adult is generally separated by the relatively small size; dark to nearly black in color; absence of pale or white bands on palpus, proboscis, and leg; predominantly dark, narrow crescent-shaped scales on scutum and scutellum; absence of scales on the pleuron and in the majority of species by the presence of acrostichal bristles and the entirely dark abdominal terga. The male is distinguished from *Lophoceraomyia* by the absence of tufts of modified setae in the antennal flagellomeres; from *Culiciomyia* by the absence of a row of lanceolate scales on the ventral surface of palpal segment 3 and in the majority of species by the following additional features: (1) presence of minor whorls of 4-15 short hairs distal to major long plumose whorls in the antennal flagellomeres 1-11 and (2) palpus as short as in the female. In the male terminalia, the subgenus is characterized by the oval or subspherical-shape of the phallosome; absence of a basal sternal process in the lateral paraproct of the proctiger; small sized proctiger crown; absence of dorsal subapical crest of spines on the dorsal subapical surface of distimere and by the reduced or poorly developed tergal lobe of segment IX. The pupa is characterized by its small size; moderately long and slender trumpet; hair 10-C of metanotum usually with a small number of branches and hair 9-VIII of abdomen placed near to the caudolateral angle. In the larva, the following characters are diagnostic: (1) head hair 1-C dark, stout spine; (2) head hairs 5, 6-C usually reduced in length and with only a few branches; (3) prothoracic hair 3-P short, about 0.25 of hairs 1 or 2-P; 4-P usually as long as or shorter than 3-P, 1-4 branched, 7-P double, 8-P single, 14-P double; (4) abdominal hairs 6-I, II double, 7-I single, 2-VIII single; (5), (6) siphon slender, from moderately long to very long, presence of 4-6 pairs of subventral tufts and (8) ventral brush of saddle with 5-6 pairs of hairs.

The distinguishing characters of the adults as summarized above are applicable to all species currently placed within *Eumelanomyia* but those of the immature stages are limited only to certain species groups in Southeast Asia and adjacent areas. Except for the male characters, the adults of *Eumelanomyia* are generally very similar to *Lophoceraomyia* and *Culiciomyia*. The female of all Oriental forms except *brevipalpis* and *phangngae* are readily separated from the members in the latter 2 subgenera by the presence of acrostichal bristles on the scutal disc. The females of *brevipalpis* and *phangngae* which lack this character resemble *Lophoceraomyia* and *Culiciomyia* rather closely but can be separated from them by the fine, narrow decumbent scales on the dorsum of vertex of the head and by the absence of a lower mesepimeral bristle. The known immature stages of some Oriental species are distinct from *Culiciomyia* and other *Culex* subgenera, but show a great deal of similarity to those of *Lophoceraomyia*. No clear-cut difference in the chaetotaxy has been found to distinguish *Eumelanomyia* pupae from those of *Lophoceraomyia*. The larvae, although showing a great deal of overlap with *Lophoceraomyia*, can be

readily separated from it by the magnitude and branching of certain hairs of the head, prothorax and abdomen and in the majority of species by the features of the siphon as indicated in the above diagnosis and in the descriptions of the subgenus.

The subgenus *Eumelanomyia*, in the current interpretation of Sirivanakarn (1971) on the basis of the male phallosome, comprises 4 major groups: *eumelanomyia*, *rubinotus-rima*, *protomelanoconion* and *mochthogenes*. In South-east Asia and adjacent areas, only 3 of the 4 groups, namely, *rubinotus-rima*, *protomelanoconion* and *mochthogenes* are represented. The *eumelanomyia* group is absent from Southeast Asia and other parts of the Oriental region and is most probably exclusively Ethiopian. Of the 27 species presently recognized from the areas under the present consideration, 2 belong to the *rubinotus-rima* group, 2 to the *protomelanoconion* group and 23 to the *mochthogenes* group. They are segregated into groups as follows: (1) *rubinotus-rima* group with *simplicicornis* and *malayensis*; (2) *protomelanoconion* group with *brevipalpis* and *phangngae* and (3) *mochthogenes* group with *uncinatus*, *foliatus*, *latifoliatus*, *hinglungensis*, *castrensis*, *calaractarum*, *baisasi*, *malayi*, *laureli*, *yeageri*, *pluvialis*, *campilunati*, *selai*, *khazani*, *tenuipalpis*, *richei*, *hayashii*, *hackeri*, *kiriensis*, *okinawae*, *iphis*, *bokorensis* and *otachati*. In addition, 1 unnamed form which at present is known only in the pupal and larval stages is also included in the *mochthogenes* group. Until adults, particularly the males, are known this form is not formally described here but the pupa and larva are diagnosed in the keys and are briefly characterized under species 28.

The 3 groups of *Eumelanomyia* in Southeast Asia and adjacent areas are basically similar in the male phallosome (particularly aedeagus) but their detailed affinities can not be completely clarified, largely because the immature stages are only partially known. As indicated in the keys to groups and in the discussion of the groups below, there is no overlap in the diagnostic adult features of the *rubinotus-rima* with the other 2 groups. The *protomelanoconion* and the *mochthogenes* groups are apparently closely related, showing several overlaps in the male characters but are strongly differentiated from each other in the immature stages. The *mochthogenes* group which is the largest in number of species is most complex and in the present study it is being subdivided into 11 subgroups. This realignment is essentially similar to the previous scheme developed by Sirivanakarn (1971) except for the detailed subdivision into additional subgroups in order to indicate more accurately the affinities of all taxa involved. For this subdivision and for the complete characterization of the groups and subgroups, see the treatment below.

AFFINITIES. *Eumelanomyia* undoubtedly belongs to the same primitive *Culex* stock as *Neoculex* and *Maillotia* on the basis of the comparatively simple male phallosome. In spite of the clear cut divergence in the phallosome types, other features of the male terminalia and the external adult morphology, as pointed out by Sirivanakarn (1971), these 3 subgenera still show many features in common and generally appear to form a well-defined group separated from the rest of *Culex*. The detailed affinities of the 3 subgenera are not clear and can not be resolved at present largely because of the lack of complete knowledge of the immature stages. However, certain evidence from the male terminalia and the adult morphology seems to warrant some speculation with regard to their probable relationships. This evidence is the intermediate condition exhibited by the species in the *seyrigi* group of *Maillotia* which resembles *Eumelanomyia* in the phallosome and other features of the male terminalia but are similar to *Neoculex* in external characters. It seems most probable that *Eumelanomyia* is an ancient derivative of the species in *Maillotia* from which it is differentiated by the complete absence of pleural scaling, darker coloration and by modifications in the male terminalia. This view is well supported by the present distribution of the 2 subgenera which overlap in the Ethiopian region. Among the 4 *Eumelanomyia* groups, the *eumelanomyia* and the *rubinotus-rima* groups appear to be the most primitive as they show closer similarity in male morphology to those of the *Maillotia* species. The *protomelanoconion* and the *mochthogenes* groups are probably of recent lineage and were perhaps derived from the other 2 groups. The presence of all 4

Eumelanomyia groups and the predominance of the *eumelanomyia* and *rubinotus-rima* groups in the Ethiopian region strongly suggest that the subgenus probably originated there.

In the Oriental region, *Eumelanomyia* shows a strong affinity with *Lophoceraomyia*. The latter is exclusively Oriental and Australasian with the range extended to the South and Western Pacific and appears to be largely overlapped by *Eumelanomyia* only in the Oriental region. Among the 3 *Eumelanomyia* groups (*rubinotus-rima*, *protomelanoconion* and *mochthogenes*), the species in the *rubinotus-rima* group show a great deal of similarity in the male morphology to *Lophoceraomyia* and it is most probable that the latter subgenus is derived from it as suggested in my earlier interpretation (Sirivanakarn 1971).

BIOLOGY. In Southeast Asia and adjacent areas, *Eumelanomyia* species are common in tropical forests in the hills or mountains away from the coastline. The adults of the majority of species have been frequently collected while resting on vegetations in the vicinity of streams or swampy ground. The breeding habitat ranges from ground pools of different sizes (most of the *mochthogenes* group species) to treeholes or bamboos (all *protomelanocoonion* group species). These habitats are, in most instances, under heavy shade; the water is fresh, containing little decayed organic matters. The ground pool forms have been frequently found in association with other *Culex* and *Anopheles* species, whereas those from treeholes or bamboos are often associated with the specimens of *Trifteroides*, *Aedes*, and *Culex* (*Lophoceraomyia*) species. The feeding habit of the females is not known and none of the species reported here has ever been incriminated in the transmission of pathogens. However, elsewhere, particularly from certain parts of South Africa, Worth and de Meillon (1960) reported the isolation of 3 different viruses from a species (*rubinotus*) in the subgenus.

KEYS TO GROUPS IN THE ORIENTAL REGION¹

FEMALES

1. Wing veins R_2 , R_3 , R_{4+5} , M_{1+2} and M_{3+4} with broad oval shaped
plume scales *RUBINOTUS-RIMA* GROUP.
Wing veins R_2 , R_3 , R_{4+5} , M_{1+2} and M_{3+4} with narrow, linear or
small clavate plume scales 2
- 2(1). Acrostichal bristles absent; lower *me*₁ bristle absent.
PROTOMELANOCONION GROUP
Acrostichal bristles present; lower *me*₁ bristles usually present.
MOCHTHOGENES GROUP

MALES

1. Palpus longer than proboscis by at least the length of terminal segment; antennal flagellomeres 1-11 without minor whorls of short and weak hairs. *RUBINOTUS-RIMA* GROUP
Palpus shorter, its length varying from 0.2 to 0.75 of proboscis; antennal flagellomeres 1-11 usually with minor whorls of short and weak hairs. 2
- 2(1). Palpus 0.75 of proboscis, segments 3-5 rather thick and irregular or distorted in shape; middle part of proboscis swollen and with several strong setae ventrally. *PROTOMELANOCONION* GROUP
Palpus usually 0.2 of proboscis, sometimes 0.75 as long; segments

The *eumelanomyia* group (Sirivanakarn 1971) is not included since it is purely Ethiopian in distribution.

3-5 uniformly very thin; proboscis slender and without above modification. *MOCHTHOGENES* GROUP

PUPAE

(Unknown in *RUBINOTUS-RIMA* GROUP)

Trumpet rather short, stout and more or less elliptical in shape, pinna without narrow slit extending to meatus; coloration of integument yellowish to dark brown. *PROTOMELANOCONION* GROUP

Trumpet relatively longer, slender and more or less cylindrical in shape, pinna with narrow slit extending to meatus; coloration of integument creamy white to almost transparent. *MOCHTHOGENES* GROUP

LARVAE

(Unknown in *RUBINOTUS-RIMA* GROUP)

Antennal hairs 2, 3-A placed apically; siphon very long and with weak and rather inconspicuous subventral tufts; distal pecten teeth 2-3 times as long as the basal ones. *PROTOMELANOCONION* GROUP

Antennal hairs 2, 3-A placed subapically; siphon moderately long and with 10-12 strong tufts on ventral surface; distal pecten teeth from 4-5 times as long as the basal ones. *MOCHTHOGENES* GROUP

RUBINOTUS-RIMA GROUP

FEMALE. Small to medium sized species; in general as described for the subgenus, with the following distinctive characters. *Head.* Decumbent scales on dorsum of vertex narrow, linear and predominantly pale yellowish; broad decumbent scales restricted to lateral patch at side; erect scales dark brown; palpus 0.2 of proboscis length; proboscis with 4 labial basal setae, 2 lateral ones as long as palpus. *Cibarial armature.* Cibarial bar with 20-24 teeth, middle 6-8 teeth narrow, pointed, and closely spaced, 6-8 lateral teeth shorter, coarser, abruptly pointed or truncate and more widely spaced. *Wing.* Plume scales on veins R_2 , R_3 , R_{4+5} and branches of M broad, oval. *Abdomen.* Terga II-VII with basolateral pale spots or with complete basal bands.

MALE. In general as in female except for the presence of complete basal bands on abdominal terga II-VII and the following. *Head.* Palpus exceeding the length of proboscis by at least the full length of segment 5; segments 4 and 5 upturned, with several dark bristles laterally and mesally; proboscis without false joint; antennal flagellum densely long plumose, minor whorls absent, normal whorls with 30-40 long hairs. *Terminalia.* Tergal lobes of segment IX poorly or very well developed; basimere slender, more or less conical; setae of subapical lobe varied, leaflet present or absent; distimere slender, sickle-shaped; phallosome subspherical or varied in shape; proctiger crown small, consisting of several fine and pointed spicules.

PUPA and LARVA. Unknown.

DISCUSSION. The *rubinotus-rima* group as established by Sirivanakarn (1971) is represented by several species in the Ethiopian region but by only 2 in the Oriental, namely *simplicicornis* Edwards 1923 and *malayensis* n. sp. They are distinct from all members of the *protomelanoconion* and *mochthogenes* groups in the broad plume scales of the wing veins, male palpus longer than proboscis and in the absence of minor whorls of short hairs on flagellomeres 1-11 of the male antenna. Both species conform to the *rubinotus* subgroup characters as defined by Sirivanakarn (loc. cit.) and are differentiated from

each other by the details of the male terminalia. The group appears to be related to the subgenus *Lophoceraomyia* on the basis of adult morphology. In Southeast Asia and adjacent areas, the *rubinotus-rima* group has been recorded only from Malaya and Borneo. The immatures and the breeding habitat are still unknown.

KEYS TO SPECIES

FEMALES

- Upper margin of posterior pronotum with 6-8 tiny setae anterior to 4-5 strong setae on posterior border. *malayensis* n. sp.
Upper margin of posterior pronotum without any setae anterior to 4-5 strong setae on posterior border. *simplicicornis*

MALES

- Tergal lobe of segment IX of male terminalia very small, 4-5 tiny setae present; distal division of subapical lobe without leaflet; lateral plate of phallosome narrowed and tapered to a point distally. *malayensis* n. sp.
Tergal lobe of segment IX of male terminalia large and prominent, about 25 strong setae present; distal division of subapical lobe with a broad leaflet laterally; lateral plate of phallosome broad and more or less subspherical in shape. *simplicicornis*

1. *Culex (Eumelanomyia) simplicicornis* Edwards
(Figs. 1A, ♂ terminalia; 1B, ♀ cibarial armature)

Culex (Neoculex) simplicicornis Edwards 1930, Bull. ent. Res. 21: 306 (♂); 1932, in Wytsman, Genera Insect. fasc. 194: 194 (taxonomy).
Culex (Eumelanomyia) simplicicornis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 3.0 mm, fore femur 1.5 mm. Medium sized, brownish species. *Head.* Decumbent scales on vertex narrow, linear and entirely pale yellowish, occupying an extensive area anteriorly, centrally and posterolaterally; lateral patch of broad decumbent scales small; erect scales entirely brown, more or less restricted to occiput; palpus 0.2 of proboscis length. *Cibarial armature* (Fig. 1B). Cibarial bar with about 24 teeth, median 6 teeth narrow, long and apically pointed, lateral 7-9 teeth coarser, shorter, apically blunt or truncate. *Thorax.* Scutal integument brown, all scales narrow, moderately dense and predominantly dark except for some yellowish ones on extreme anterior promontory; acrostichal bristles present; *p_{pn}* without setae or scales anterior to posterior bristles; pleuron same color as scutum, scales absent; *p_{pl}* with 1 or 2 dark strong setae and 4-5 yellowish hairlike setae; 1 strong, dark, lower *mep* bristle present. *Legs.* All femora, tibiae and tarsi brown to black scaled. *Wing.* Scales broad oval, dark and rather dense on all veins. *Abdomen.* Terga with basolateral pale spots on III-VII; sterna entirely pale scaled.

MALE. In general similar to female, differing in the following. *Head.* Palpus exceeding the length of proboscis by 1.5 of the length of segment 5; segment 3 with a ventral row of tiny hairs in apical 0.5, its apex bears 2 or 3 bristles laterally; segments 4 and 5 upturned, moderately to strongly plumose; proboscis slender, uniformly thick, labial false joint absent, labial basal setae 4-5 in number, all dark, long, hairlike as in female; antennal flagellar whorls densely long, plumose, minor whorls of shorter hairs absent. *Abdomen.* Terga II-VII with distinct basal pale bands. *Terminalia* (Fig. 1A). Tergal lobe of segment IX large, prominent, with about 25 strong bristle-like setae; basimere

slender, conical, inner tergal surface with 2 rows of 10-12 strong submarginal setae and several other weak ones; area laterad of subapical lobe practically bare; subapical lobe broad, proximal division with 3 subequal rod-like setae, all with weakly hooked apices, distal division more or less separated from proximal, with 1 strong basal seta and 1 very broad acuminate or blunt tipped leaflet laterally and 2 short blade-like setae, 1 long, narrow blunt tipped leaflet mesally; distimere sickle-shaped, uniformly thick from base to 0.75 of the length, distal 0.25 tapered into a small, slightly recurved apex; ventral subapical seta present near middle, dorsal one present, subapical claw slender and moderately long; phallosome subspherical in tergal view, lateral plate broad oval, with a slender internal blade-like process, its tergal surface with 15-20 strong denticles; proctiger crown small, with 15-20 dark pointed spines, lateral paraproct thin; 1 cercal seta present.

PUPA and LARVA. Unknown.

TYPE DATA. Lectotype: male, marked as type by Edwards, with attached terminalia mount, Samawang Jungle, near Sandakan, *Sabah, East Malaysia*, MALAYSIA, 11 July 1927, H. M. Pendlebury (BM). PRESENT SELECTION.

DISTRIBUTION. Known only from East Malaysia. Material examined: 5♂ and 2♀.

MALAYSIA. *East Malaysia: Sabah*, near Sandakan, Samawang Jungle, 4♂, 1♀; Tawau, 1♂; Sinapokan, 1♀.

TAXONOMIC DISCUSSION. The description of *simplicicornis* by Edwards (1930) was based on males only and no illustration was provided. I have, however, checked the males in the type series and found them agreeing very well with his description of this species. The description of the female given above is based on 2 specimens, one of which bears similar field notes as the males in the type series and the other is from Sinapokan (presumably also in *Sabah*). Except for the absence of complete basal bands on the abdominal terga, these females are generally very similar to the males and their association with this species is probably correct.

C. simplicicornis is readily distinguished from the members in the *protomelanoconion* and *mochthogenes* groups in the female by the cibarial armature and in the male by the length of palpus, absence of the minor whorl in the antenna and by details of the terminalia as described above. It can also be readily separated in general by the broad scales on the wing veins as indicated in the key to groups. As pointed out by Edwards (1930: 306), *simplicicornis* is quite similar to the species in the subgenus *Lophoceraomyia* from which it differs, however, in the absence of modified scales or setae in the male antennal flagellum. The male terminalia of *simplicicornis* is also distinct from the latter subgenus and apparently shows general resemblance to the members of the *protomelanoconion* group and of the *tenuipalpis* subgroups of the *mochthogenes* group.

BIOLOGY. The adults of *simplicicornis* were collected under forest canopy. The breeding habitat is not known.

2. *Culex (Eumelanomyia) malayensis* n. sp. (Figs. 1C, ♂ terminalia; 1D, ♀ cibarial armature)

FEMALE. Wing 2.7 mm, fore femur 1.4 mm, proboscis 1.9 mm. Small to medium sized, brown to dark brown species with external general characters as described for *simplicicornis*, differing particularly in the following. *Cibarial armature*. (Fig. 1D). Cibarial bar with larger lateral teeth, 6-8 median teeth narrower, longer and more closely spaced. *Thorax*. Upper part of posterior pronotum with 1 or 2 irregular rows of 6-8 short setae cephalad of posterior bristles. *Abdomen*. Tera II-VII with median basal pale spots and basolateral pale spots which sometimes form complete basal bands.

MALE. As in female, very similar to *simplicicornis*, differing chiefly in the following. *Head*. Palpus shorter, its length exceeding proboscis by full length of segment 5; flagellar whorls of antenna more strongly plumose. *Abdomen*. Tergum II with basal median pale spot, terga III-VII with broader basal

pale bands; sterna III-VII with pale basal bands as in terga. *Terminalia*. (Fig. 1C). Tergal lobe of segment IX very small, with 4-5 setae (only alveoli seen); basimere broad, conical, inner tergal surface without specialized submarginal setae; subapical lobe small, not clearly divided into proximal and distal divisions; 3 proximal rods slender and thin, followed distally by 1 or 2 fine hair-like setae and 3-4 very narrow blade-like setae, leaflets absent; distimere stout, slightly curved at middle; subapical claw rather long and hooked apically; phallosome (lateral view only) strongly sclerotized, lateral plate broad basally, reduced to a short pointed process apically; proctiger crown small, consisting of a small number of fine and pointed spicules, lateral paraproct with a rounded apical lobe; 2 cercal setae present.

PUPA and LARVA. Unknown.

TYPE DATA. Holotype: male with terminalia on slide, Rantau, Panjang, Kelantan, WEST MALAYSIA, 18 December 1956; allotype female with slide of cibarial armature (70/698); paratype: 1 female, same data as holotype; 3 females, Pacific Tin, Selangor, WEST MALAYSIA, August-October 1965 (USNM).

DISTRIBUTION. Known only from the type locality and Pacific Tin, Selangor, WEST MALAYSIA. Material examined: 1♂, 5♀, as indicated in the type data.

TAXONOMIC DISCUSSION. *C. malayensis* n. sp. exhibits a great deal of similarity to *simplicicornis* in the general adult characters but is readily distinguished from it by several details of the male terminalia. The only external adult character which I also found reliable for separating this species from *simplicicornis* is the presence of a number of short setae on the upper margin of the posterior pronotum. The above description of the male terminalia of *malayensis* is based only on a single prepared slide and because of the dissection and orientation of parts, it is not possible to describe the phallosome shape from the tergal view. The lateral plate of the phallosome, which is described and figured here, is made from the lateral view only. As indicated in the key and in the above description, this species is quite distinct from *simplicicornis* in the details of the basimere, distimere, tergal lobe of segment IX and in the type of phallosome. The female also shows variation in the extent of basal pale bands on the abdominal terga much as in *simplicicornis*.

BIOLOGY. *C. malayensis* is apparently rare. The adults were collected (presumably by net) from only two localities in West Malaysia. The breeding habitat is not known.

PROTOMELANOCONION GROUP

FEMALE. Small to medium sized species. *Head*. Center of vertex with narrow yellowish decumbent scales; erect scales numerous, usually pale anteriorly, dark posterolaterally; lateral labial basal setae of proboscis as long as palpus. *Cibarial armature*. Poorly developed; cibarial bar with 20-22 minute teeth in the middle, 2-4 median teeth long, lateral ones reduced in length. *Thorax*. Anterior half of scutal disc without acrostichal bristles; dorsocentral bristles very strong and dark; pleuron much paler than scutal integument; lower *me* bristle absent. *Wing*. Plume scales on branches of veins R and M narrow, linear and moderately dense. *Abdomen*. Terga entirely dark; sterna paler scaled.

MALE. Similar to female in general appearance. *Head*. Palpus about 0.75 of the length of proboscis, segments 3, 4 and 5 strongly distorted in shape; proboscis rather thick, middle part swollen and with several strong setae on ventral surface; antennal flagellomeres 1-11 with minor whorls of 10-15 short hairs in addition to a large normal whorl of 35-40 hairs. *Terminalia*. Tergal lobe of segment IX small with 6-9 moderately long setae; basimere with 1 or 2 submarginal setae on its inner tergal surface; subapical lobe short or elongate; proximal division with 3 stout rods, leaflet of distal division large or small; distimere slender, sickle shaped and long; phallosome typically oval or slightly modified; number of denticles varied; proctiger crown small, with

coarse and blunt spines laterally and fine pointed spines internally.

PUPA. Cephalothorax and abdomen yellowish to dark brown; trumpet darker; paddle very pale to almost transparent. Trumpet short and stout, somewhat elliptical, apex truncate; pinna with slit not extended to meatus. *Cephalothorax* and *Metanotum*. Hair 8-C double; 9-C usually single, rarely double; 10-C usually 6-7b. *Abdomen*. Hairs 5-IV-VI usually 3, 2 or 3 and 3b respectively; 6-III, IV usually double; 6-V, VI usually single.

LARVA. Head capsule, siphon and saddle light brown to dark brown. The following features are diagnostic. *Head*. Antennal hairs 2, 3-A placed at apex as hairs 4-6-A; 1-C a dark stout and pointed spine; 5, 6-C equally strong and subequal in length, each 2 or 3b. *Thorax*. Hair 4-P a little longer than 3-P, usually 3 or 4b; 7-P double; 8-P single; 14-P double. *Abdomen*. Hairs 6-I, II and 7-I varied in color and thickness, all double; 6-III-V double; 6-VI single and twice as long as 6-III-V; comb scales numerous, all with apical fringe of fine spines; hair 2-VIII single. *Siphon*. Very long and uniformly cylindrical; pecten teeth small, distal teeth a little longer than the basal ones; 4 pairs of subventral tufts present but minute and widely spaced; median caudal filament of spiracular apparatus absent. *Anal segment*. Hair 2-X of saddle single; ventral brush with 5 pairs (total 10) of hairs, all inserted within the grid.

DISCUSSION. The *protomelanoconion* group is represented in Southeast Asia and adjacent areas by 2 very closely related species: *brevipalpis* (Giles) and *phangngae* n. sp. Both are undoubtedly related to *horridus* Edwards from the Ethiopian region and to *stellatus* Someren from the Seychelles. They show a strong affinity with the members of the *mochthogenes* group on the basis of male antenna and terminalia but are distinct from the latter in the absence of acrostichal bristles on scutal disc and in several features of the pupa and larva. The 2 Southeast Asian species are extremely similar in the external characters of adults and pupa, but can be differentiated from one another with certainty by the detail of the male terminalia and by a few larval hairs as indicated in the keys below. *C. brevipalpis* is most common and very widely spread in the Oriental region with the range extending to the Papuan part of the Australasian region. *C. phangngae* is now known only from Thailand and it is probable that it may also occur in other parts of the Indomalayan areas. The most frequent breeding sites of these species are either treeholes or bamboos.

KEYS TO SPECIES

MALES

- Lateral plate of phallosome typically oval-shaped, denticles rather fine, about 20 in number; subapical lobe not elongated; basimere about 0.22 mm in length (fig. 2A). *brevipalpis*
 Lateral plate of phallosome with pronounced angle on upper lateral margin; denticles coarser, more numerous, about 30 or more in number; subapical lobe elongated; basimere longer, about 0.25-0.29 mm in length (Fig. 2D). *phangngae* n. sp.

LARVAE

- Abdominal hairs 6-I, II and 7-I pale yellowish and tapered to a fine point apically. *brevipalpis*
 Abdominal hairs 6-I, II and 7-I very dark brownish and abruptly tapered to a point apically. *phangngae* n. sp.

3. *Culex (Eumelanomyia) brevifalpis* (Giles)
(Figs. 2A, ♂ terminalia; 2B, ♂ antennal flagellum;
2C, ♀ cibarial armature; 3A, pupa; 3B, larva)

- Stegomyia brevifalpis* Giles 1902, Handb. 2nd ed.: 384 (♂, ♀).
Culex longipes Theobald 1901, Mon. Cul 2: 68 (♀). Preoccupied by *Culex longipes* Fabricius (1850: 34).
Culex brevifalpis Theobald 1903, Mon. Cul 3: 146 (♂, ♀); Barraud 1924a, Indian J. med. Res. 11: 1277 (♂, ♀); 1924b, Indian J. med. Res. 12: 432 (L*); Borel 1926, Arch. Inst. Pasteur Indo-Chine 3-4:40 (♂, ♀ L*); Borel 1930, Mon. Coll. Soc. Path. exot. 3: 365 (♂, ♀, L*);
Culex macropus Blanchard 1905, Les Moustiques :327. New name for *Culex longipes* Theobald 1901; synonymy with *Culex brevifalpis* by Barraud 1924a, Indian J. med. Res. 11: 1277.
Melanoconion uniformis Leicester 1908, Cul. Malaya, 3: 136 (♂, ♀). Considered as *Cyathomyia brevifalpis* by Edwards 1913, Bull. ent. Res. 4: 237; synonymy with *Culex brevifalpis* by Barraud 1924a, Indian J. med. Res. 11: 1277.
Culex fidelis Dyar 1920, Insec. Inscit. menst. 8: 180 (♂). Synonymy with *Culex brevifalpis* by Edwards 1929, Notul. ent. 9: 4.
Culex (Neoculex) brevifalpis, Edwards 1932, in Wytzman, Genera Insect. fasc. 194: 194 (taxonomy); Barraud 1934, Fauna Brit. India, Diptera 5: 348-351 (♂, ♀, L*); Baisas 1935, Philipp. J. Sci. 57: 177 (♂, ♀); Lee 1944, Atlas mosq. larvae, Australasian Region, 1277 (L*); Bohart 1945, U. S. Navmed 580: 72 (♂, L); Bohart and Ingram 1946, U. S. Navmed 1055: 72 (♂, ♀, L*); Bonne-Wepster 1954, Roy. trop. Inst. Amst. Spec. Pub. 111: 109 (♂, ♀, L*); Lien 1962, Pacif. Ins. 4: 631 (distribution); Delfinado 1966, Mem. Amer. Ent. Inst. 7: 125 (♂, ♀, P*, L*); Bram 1967, Contrib. Amer. Ent. Inst. 2: 25 (♂, ♀, P*, L*);
Culex (Eumelanomyia) brevifalpis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.6-3.6 mm, fore femur 1.7-1.9 mm, proboscis 1.7-2.1 mm, abdomen 2.0-2.3 mm. As figured by Bram (1967: 26); in general extremely dark to black species; reared specimens with a considerable amount of greenish tint on pleuron and coxae. **Head.** Decumbent scales of vertex narrow, yellowish white anteriorly, forming a distinct ocular line; scales at side of eye broad, aggregating into a distinct white or bluish white patch; erect scales numerous, color variable from light brown to dark or sometimes pale anteriorly, dark posterolaterally; interocular setae strong and dark; dorsal ocular setae moderately strong; palpus 4-segmented, about 0.2 of the length of proboscis, segments 2, 3 bears a strong seta each; proboscis with 4 labial basal setae, 2 lateral ones strong, bristle-like and as long as palpus; antenna slightly longer or equal to proboscis; pedicel very pale, with some minute hairs or scales on its inner dorsal surface; flagellar whorl with 5 or 6 weak hairs. **Cibarial armature** (Fig. 2C). As figured, with about 20-22 poorly developed teeth in the middle of bar, median teeth longest, lateral ones gradually shorter, both ends of lateral flanges without teeth. **Thorax.** Scales on scutum and scutellum narrow, predominantly dark except for a few pale ones on anterior promontory, lateral margin of fossa and antealar areas; acrostichal bristles absent except on extreme anterior promontory; dorsocentral bristles very strong and dark; *apn* with 1-3 dark and strong bristles anteriorly and some yellow hairs and narrow scales posteriorly; *p1n* with some scattered pale narrow scales; pleuron very pale, contrasting sharply with dark scutum; *ppl* with 1 strong bristle and a few other weak and yellow hairs; upper corner and posterior border of *stp* with a few pale translucent scales and a few short weak hairs; lower posterior border of *stp* with a strong and dark bristle and a few short, weak hairs; anterior lower *mep* bristle absent; posterior upper *mep* with a small patch of 4-5 weak, yellowish bristles. **Legs.** Coxae and trochanters pale, concolorous with pleuron; fore coxa with anterior patch of white

scales and several weak setae; mid coxa with a lateral white patch of scales and a row of 3 strong and dark bristles; hind coxa with anterior scale patch and a posterior row of 6-10 bristles; fore and mid femora dark anteriorly and laterally, white ventrally; anterior surface of hind femur pale in basal half, dark distally and laterally; tibiae and tarsi completely dark scaled. *Wing*. All scales black and narrow. *Abdomen*. Terga usually entirely dark scaled but VI, VII sometimes with basolateral pale spots; sterna yellowish white scaled.

MALE. Similar to female in general features, differing in sexual characters as in the following. *Head*. As figured by Bram (1967: 26); palpus 0.75 of the length of proboscis, 5-segmented; segments 2 and 3 equal in length, distal half of segment 3 thickened and slightly bent, with a group of several short and strong spines on ventral and mesal surfaces, its apex with a tuft of about 10 strong and curved spines mesally; segment 4 stout, thickened in basal half, narrow in distal half, with several spines and setae ventrally and mesally, its apical 0.2 with a row of 4-5 strong spines; segment 5 very short, slightly up-turned, distorted in shape, with several setae and bristles on its apex; proboscis thick, middle part swollen and bearing several strong hairs on ventral surface; labial basal setae weak, 4 in number; flagellar whorls of antenna strongly plumose, normal whorl with 35-40 hairs, minor whorl with 10-15 short and weak hairs (Fig. 2B). *Terminalia* (Fig. 2A). Segment IX with small tergal lobes bearing 6-9 setae; basimere slender, conical, about 0.22 mm in length; inner tergal surface concave, marginal setae sparse, 1 or 2 moderately strong submarginal setae present; subapical lobe not divided into proximal and distal divisions; proximally with 3 rod-like setae, most distal rods thinner than other two rods, all with hooked apices; distally with 1 strong external seta, 1 narrow, indistinct leaflet, 1 short, hair-like and 2-3 narrow blade-like setae; distimere long and slender, distally tapered to a blunt point, terminal claw slender, placed near to apex; ventral subapical seta present, dorsal one present or absent; phallosome with 2 oval-shaped lateral plates connected at middle by a broad tergal bridge, upper tergal surface with about 20 denticles, lower area bare, lateral margin smooth; proctiger crown small or medium sized, with coarse spicules laterally and fine pointed spicules internally; cercal setae minute, usually 3 in number.

PUPA (Fig. 3A). Abdomen 2.0-3.0 mm, paddle 0.46-0.52 mm, trumpet 0.36-0.52 mm, index about 7. As figured; general coloration yellowish brown to dark brown; trumpet dark brown, stout and relatively short, more or less elliptical in shape; the following chaetotaxy is diagnostic. *Cephalothorax* and *Metanotum*. Hair 1-C usually 4b(3-6); 3-C double; 6-C 4 or 5b; 8-C double; 9-C usually single (1-2); 10-C usually 6-7b(4-8); 11-C always single, lightly pectinate; 12-C usually triple (2-4). *Abdomen*. Hairs 3-I-III single; 1-III-VII usually 14(10-18), 7(6-10), 5(4-7), 4-5(3-7) and 3(2-4)b respectively; 5-IV-VI usually 3(2-5), 3(2-3) and 3(2-3)b respectively; 6-III, IV usually double (1-3); 6-V, VI usually single (1-2); 2-VII always lateral to 1-VII; 9-VII usually 6b(4-7); 9-VIII 8 or 9b, placed very close to caudolateral angle. *Paddle*. Very pale and rather transparent, contrasting sharply with abdomen or cephalothorax, midrib moderately strong and lightly pigmented, external buttress distinct, distal margin indistinct; hair 1-P absent; 2-P present; genital lobe of male pupa about 0.5 of paddle length.

LARVA (Fig. 3B). Head 0.65-0.75 mm, siphon 1.5-3.0 mm, index 12-15, saddle 0.23-0.3 mm, siphon/saddle ratio 7-10. Coloration of head capsule, siphon and saddle yellowish brown to dark brown, sometimes paler; thorax and abdomen in live specimens dark bluish or greenish. *Head*. Antennal shaft entirely cream colored or dark brown; spicules moderately dense and fine; hair 1-A strongly plumose, inserted at about 0.75 of the length from base; hairs 2, 3-A placed apically as 4-6-A; labrum narrow, head hair 1-C dark, stout spine-like; 4-C single and long, about 2-3 times as long as distance between bases; 5-C usually 3b(2-4); 6-C usually 2b(2-3); 12-C rather weak and short, about the same magnitude as 14- or 15-C, usually 5b(4-6); mental plate with a large median tooth and 7-9 smaller lateral teeth on each side; hairs 16, 17-C absent. *Thorax*. Hair 3-P weak and short, about 0.25 of the length of 1

or 2-P, always single; 4-P nearly as long as 1 or 2-P, usually triple (2-4); 7-P usually double (2-3); 8-P single or double; 14-P double. *Abdomen*. Hairs 6, 7-I and 6-II double, all pale yellowish, with apices terminated into fine points; 6-III-V double; 6-VI twice as long as 6-III-V, always single; 1-III-VI usually 5(4-5), 5, 5-6 and 4(3-4)b respectively; all other hairs rather weak and short; comb scales about 40 in number, all with an even fringe of fine spines apically; scales in posterior row slightly longer than those in anterior row, middle scales intermediate in length; hair 2-VIII single. *Siphon*. Very slender and usually very long, more or less uniformly cylindrical; pecten teeth 12-15 in number, distal teeth with 8-10 fine denticles; siphonal hair tufts usually 5 pairs (4-5) in number, inserted subventrally, all very weak, short, widely spaced and rather inconspicuous, 3-4b each; hair 2-S very weak and short; median caudal filament absent. *Anal segment*. Hair 2-X single; ventral brush dark, with 5 pairs of hairs, all inserted within grid; anal gills tubular, apices blunt, slightly longer than saddle.

TYPE DATA. (1) *Culex longipes* Theobald 1901, holotype: female, SINGAPORE (BM). (2) *Stegomyia brevialpis* Giles 1902, Lectotype: male with attached terminalia mount, Shajahnapur, United Provinces, INDIA (BM); SELECTION OF BRAM (1967: 29). (3) *Melanoconion uniformis* Leicester 1908, lectotype: male with attached terminalia mount, Kuala Lumpur, West Malaysia, MALAYSIA (BM); SELECTION OF BRAM (1967: 29). (4) *Culex fidelis* Dyar 1920, lectotype: male, Los Banos, PHILIPPINES (USNM); SELECTION OF STONE AND BOHART (1944: 220)

DISTRIBUTION. Material examined: 449♂, 485♀, 47 P, 90 L; 380 with associated skins (125 p, 255 lp).

INDIA. Assam: Chabua; Dibrugarh; Rupsi; 4♂, 3♀. Bengal: Calcutta-Botanical Garden; Bihar-Purnea; 1♀, 4 L.

BURMA. Rangoon; 3♂, 3♀; 6 lp.

CHINA. Canton; 1♂. Hainan Island; 2♂, 7♀.

TAIWAN. Pingtung: Santi-Santi; 1♀.

RYUKYU ISLANDS. Okinawa: Nakasoni; Shona Won; 1♂, 4♀, 5 L.

THAILAND. Mae Hong Son: Ban Mae Ho Nua; Ban Pha Chi; Doi Chang; 22♂, 22♀. Chiang Mai: Muang; Huey Chang Kien; Doi Sute; Ban Tha Lan; Ban Mae Kung; Doi Jom Jang; Huey Hin; Doi Huey Mae; Huey Kaeow; Ban Hua Muang; Saraphi; San Kam Paeng; Mae Pim; 62♂, 70♀, 20 p, 87 lp. Lampang: Ngao, 1♂, 1♀. Lamphun: Lee, 3♀. Nan: Doi Chick Chang; Ban Wang Mo; Ban Pha Man; Tak Huey Rong; Ban Ta Lai; Ban Pha Hang; 11♂, 12♀, 1 P, 1 L, 2 p, 5 lp. Tak: Khao Salak Phra; 4♂, 1♀; 1 p, 4 lp. Phrae: Saeng, Canton Ban Khlong; 1♂, 1♀. Udon Thani: Muang Ban Kau Noi; Ban Nong Bua; Ban Pha Jut Wat Po; Ban Dong Nadee; 8♂, 10♀. Sakon Nakhon: Muang nr. hospital, 1♂. Khon Kaen: Phu Wiang; Ban Muang Khao; 18♂, 18♀, 1 P, 1 L. Ubon Ratchathani: Pibul Mung Sahan chong Mek; 1♂, 1♀. Nakhon Sawan: Ban Talad Tai; Khas Phnom Set; Ban Pak Nam; 19♂, 16♀, 11 p, 33 lp. Nakhon Ratchasima: Pak Chong; Pha Khlong Mai; Wang Ta Khlong; Khao Suan Hom; Ban Kae Chae; Khai Pai; 14♂, 12♀, 6 p, 9 lp. Nakhon Nayok: Muang, Krong Kaeow Water Fall; Pha Kluey Mai; Saliga; Nang Rong Water Fall; Ka Ang Water Fall; Khao Eto; 10♂, 11♀, 2 P, 2 L, 8 p, 7 lp. Kanchanaburi: Muang; Baw Ploy, Khien Sien Village; Huey Lin Tin; Juey Mae Nam Noi; Ban Sai Yok; Huey Bong Ti; Khao Saeng; Khao Nga Chang; 20♂, 35♀, 9 P, 7 L, 7 p, 23 lp. Nonthaburi: Muang-Mu 2, 1♀; 1 lp. Ayuthaya: Bang Pa In, 12♂, 24♀, 2 p, 3 l. Thon Buri: Bang Plad, 1♂, 2♀, 1 P, 1 L, 2 ll. Chon Buri: Bang La Mung-Khao Mai Kaeow; Koh Sri Chung; Huey Kum; 10♂, 23♀, 5P, 2L, 7 p, 9 lp. Chanthaburi: Ban Tha Mai; Ban Laem Sing; Khao Phra Bath; Khao Hin Paeng; 4♂, 3♀, 4 p, 1 lp. Trad: Laem Ngob, Ban Dan Mai; Hard Sai Daeng; 3♂, 5♀, 1 P, 1 L, 1 lp. Frachaut Khiri Khan: Muang Khlong Van Hill; Tub Sakae, Huey Yang Water Fall; 10♂, 3♀, 1 p. Ranong: Muang, Wat Waree Ban Pot; Kraburi, Pet Kasem Road; Koh Chang; Ban Chattri; Khlong Bang Man; 11♂, 16♀, 9 p, 5 lp. Surat Thani: Koh Samui, Khao Yai; Ko Mae Ko; Ban Li Pha Noi; 12♂, 22♀, 5 P, 1 L, 19 p, 12 lp. Phangnga: Thap Wen, 7♂, 2♀, 6 p, 2 lp. Nakhon Si Thammarat: Chaung Khao; Ban Thuen Lek; 3♂, 1 p, 2 lp. Trang: Muang, National Park; Kan Tang; 6♂,

5♀, 3 p, 5 lp. *Fhattalung*: 7♂, 6♀, 4 p, 8 lp. *Narathiwat*: Wang, 2♂.

CAMBODIA. *Phnom Penh*: 7♂, 1♀. *Ari Ksatr*, 2♂, 1♀.

S. VIETNAM. *Saigon*; *Bien Hoa*; *Con Son*; *Quang Duc*, Bu Prang; *Phuoc Tuy*, Vung Tau Village; *Gia Dinh*; *Tay Ninh*; *An Khe*; *Cam Ranh*; 12♂, 11♀, 22 L, 4 p, 10 lp.

MALAYSIA. *West Malaysia*: *Selangor*- Ulu Gombak; Ulu Langat; Kepong; The Gap; Kg. Juar P. Tioman; Ampang Forest Reserve, 16 mi from Bentong; Gunong Benom Bale Camp; Ulu Klang; 36♂, 28♀, 7 p, 17 lp. *Pahang*- Padang Tengku Lipis; Mela K. Lipis; 8♂, 6♀, 1 p, 3 lp. *Kelantan* - Gua Musang; Bertam; 5♂, 2♀.

INDONESIA. *Borneo*: (Kalimantan): Samarinda, 1♂. *Java*: Chilachap; Djakarta; Bogor Kebun Raja; 11♂, 6♀, 9 P, 3 L, 4 lp. *Alor*: Kalabahi, 1♂. *Morotai*: Raeo Island, 2♂. *West Irian*: Cyclops mountains, 2♂.

PHILIPPINES. *Luzon*: Agoo La Union; Baguio; Subic Bay; Balaoan La Union; Los Banos; Camansi La Union; Laguna, Mt. Makiling; 31♂, 20♀, 7 L, 4 lp. *Mindoro*: San Jose, 10♂, 22♀, 19 L. *Falawan*: Puerto Princesa; Irahnan River; Rosa Island; 2♂. *Mindanao*: Pasanco Zamboanga; Parang; Kabakan; 28♂, 43♀, 3 lp.

Additional records from the literature: CEYLON (Barraud 1934); INDONESIA, (Bonne-Wepster 1954); BISMARCK ARCHIPELAGO (Lee 1944)

TAXONOMIC DISCUSSION. *C. brevipalpis* is one of the most dominant and widely spread species of the subgenus in Southeast Asia and adjacent areas. It is readily separated from the other forms of *Eumelanomyia* except *thangngae* by the structure of the male palpus and proboscis and by several features of the pupa and larva. Because of the absence of acrostichal bristles on the scutal disc, the females of *brevipalpis* are easily confused with *Lophoceraomyia* and *Culiciomyia* from which they are, however, distinguished by the narrow decumbent scales on the vertex and by the absence of the lower mesepimeral bristle. The female cibarial armature as described and figured here is also quite distinct in the presence of relatively few and poorly developed teeth. The immature stages differ from other forms of *Eumelanomyia* as indicated in the keys to groups, but show a great deal of similarity to *Lophoceraomyia* from which they are separated as follows: In the pupa, it is distinguished by (1) shape and reduced length of the trumpet; (2) multibranching of hair 10-C; (3) the triple branching of hairs 5-IV-VI and (4) the absence of paddle hair 1-P. The larva differs in (1) the triple branching of prothoracic hair 4-P; (2) the double branching of hairs 6-I, II; (3) having abdominal hair 6-VI unbranched and (4) the uniformly cylindrical shape of the siphon.

There are apparently no significant variations in the diagnostic characters of *brevipalpis* from several parts of Southeast Asia and all of the specimens which have been studied so far essentially conform to a single type. The adult characters which are subjected to a great deal of individual variation are the general size and the presence or absence of basolateral pale spots on the abdominal terga. The larva shows a great deal of variation in the length of the siphon, but is quite constant in several features of the chaetotaxy as noted above.

BIOLOGY. The most frequent breeding sites of *brevipalpis* are treeholes and bamboos in which the immature stages have usually been collected in great numbers. On certain occasions, they have also been collected from other containers such as coconut shells, water jugs, discarded barrels and stone basins. The few collections from ground pools as noted by Bram (1967) are probably incorrect. The larval and adult collections were made from a broad range of elevation in the virgin tropical forest, bamboo bushes or plantation areas. Although in certain instances, *brevipalpis* has been found to occur near human dwellings, the adults thus far have never been collected biting man or other domestic animals. Bonne-Wepster (1954) noted that the female may attack man near the breeding places but this has not been supported by the extensive field data either in the previous literature or in the present reports.

4. *Culex (Eumelanomyia) phangngae* n. sp.

(Fig. 2D, ♂ terminalia)

FEMALE. Wing 2.5-3.0 mm, fore femur 1.5-1.7 mm, proboscis 1.5-1.8 mm, abdomen 1.7 mm. Essentially as described for *brevipalpis* from which it is indistinguishable. Abdominal terga entirely dark, pale basolateral spots completely absent. *Cibarial armature.* As described and figured for *brevipalpis*.

MALE. Similar to female, differing from *brevipalpis* particularly in the following characters. *Head.* Flagellar whorls of antenna rather weakly plumose. *Terminalia* (Fig. 2D). As figured; generally similar to *brevipalpis*, but differing in having a larger basimere, of which the length ranges from 0.25-0.29 mm.; subapical lobe rather prominent, somewhat elongate, proximal division with the most proximal rod strongly bent in the middle, the other two rods gently curved, distal division with a broader acuminate leaflet and a stronger basal seta laterally, 1 strong, short, hairlike and 2 minute setae mesally; lateral plate of phallosome most distinctive, with a pronounced angle on upper lateral margin, dorsal half tapered to a blunt apex, denticles coarser and more numerous, about 30 or more present; proctiger crown with stronger spicules.

PUPA. Essentially as described and figured for *brevipalpis*, differing only in having a broader and longer male genital lobe which is nearly two-thirds of paddle length.

LARVA. Very similar to *brevipalpis* in general and in almost all details of chaetotaxy, differing particularly in having abdominal hairs 6 and 7 of segment I and hair 6 of segment II very dark and stout with apices abruptly ended in a point.

TYPE DATA. Holotype: male (01745-1) with associated pupal and larval skins and terminalia slide, Nam Tai, *Phangnga*, THAILAND, split bamboo lying on the ground, elevation 200 meters, October 18, 1966, E. L. Peyton. Allotype: female (01745-4) with associated pupal and larval skins. Paratypes: 1 male (01745-2) with associated pupal and larval skins and terminalia slide; 2 females (01745-3, 5) with associated pupal and larval skins; 1 male (01746-109) with associated pupal skin and terminalia slide; 1 male (01828-100) with associated pupal skin and terminalia slide; 1 male (01830) with terminalia slide, October 22, 1966, C. Dhirapat, same locality as holotype (USNM).

DISTRIBUTION. Known only from the South of Thailand. Material examined: 12♂, 21♀, 23 L; 24 with associated skins (11 p, 13 lp).

THAILAND. *Phangnga*: Nam Tai; Thap Wen; 12♂, 21♀, 22 L; 9 p, 8 lp. *Nakhon Si Thammarat*: Ban Sai Kae, 1 L.

TAXONOMIC DISCUSSION. *C. phangngae* is extremely similar to *brevipalpis* in all stages but is separable from the latter in the male terminalia by the features of the phallosome and other details of the basimere and distimere as indicated in the key and as described above. The larva is also distinct from *brevipalpis* in having abdominal hairs 6-I, II and 7-I darker and stronger. The two forms overlap in distribution in the locality where *phangngae* was found without an apparent intergradation in the diagnostic male characters indicating that they are undoubtedly distinct.

BIOLOGY. As in *brevipalpis*, the most frequent breeding sites of *phangngae* are in bamboos but rarely in treeholes. All of the adults were obtained from either individual or mass rearing. Nothing more is known about its biology.

MOCHTHOGENES GROUP

FEMALE. Minute, small or medium sized species, rarely large. *Head.* Decumbent scales on anterior dorsal margin and in center of vertex varied; erect scales usually entirely dark; lateral patch of broad scales dark or pale; palpus usually 0.2 of proboscis length, sometimes shorter; labial basal setae usually as long as or longer than palpus, rarely shorter. *Cibarial armature.* Very well developed; number and type of teeth varied. *Thorax.* Anterior half

of scutal disc usually with several, rarely only a few acrostichal bristles; scutal scales narrow, fine and predominantly dark; pleuron usually dark on the upper part, pale below; lower *mep* bristle usually present, sometimes absent. *Wing*. Plume scales on veins R_2 , R_3 , R_{4+5} and branches of M small, narrow, linear or clavate and moderately dense. *Abdomen*. Terga usually entirely dark, rarely with basal pale bands or basolateral pale spots; sterna usually paler than terga.

MALE. As in female except for the following. *Head*. Palpus usually from 0.12 to 0.2 of proboscis length, sometimes longer to 0.5 or 0.75; labial false joint present or absent; antennal flagellum weakly to strongly plumose, flagellomeres 1-11 usually with minor whorls of 4-15 short and weak hairs in addition to large normal whorls of 10-40 long hairs. *Terminalia*. Varied; tergal lobe of segment IX usually small, sometimes well developed; basimere usually small, slender, roughly conical, rarely large or modified; subapical lobe clearly divided into proximal and distal divisions or not, proximal division with 3 rod-like setae, number and type of setae on distal division varied; distimere sickle-shaped or modified; phallosome broad oval or subspherical, sometimes modified, denticles usually present, rarely absent; proctiger crown small-medium sized, consisting of a few flat and blunt and several fine pointed spicules.

PUPA. Coloration of integument very pale to almost completely transparent; wing, leg, antennal, palpal and labial cases partially dark; trumpet dark, uniformly cylindrical, length varying from 0.4 to 0.6 mm, index 8-10, pinna with a narrow slit extended to meatus. All hairs present and usually weak; the combination of following hairs are characteristic. *Cephalothorax* and *Metanotum*. Hair 8-C 2-4b; 9-C usually double, rarely single; 10-C usually double, sometimes more branched. *Abdomen*. Hair 5-IV double or triple, rarely single; 5-V, VI usually double, rarely single or triple; 6-III-VI 2-5b, rarely single; 9-VII double or triple, subequal in length to 9-VIII or slightly shorter; 9-VIII 5-6b, usually placed near to caudolateral angle, sometimes well removed cephalad. *Paddle*. External buttress moderately strong; distal margin indistinct; midrib lightly pigmented and weakly sclerotized.

LARVA. Head entirely pale or with pattern of dark and light areas; siphon usually pale or cream-colored, rarely dark or with median dark ring. The following characters are diagnostic. *Head*. Antennal hairs 2, 3-A subapical; hair 1-C a moderately stout and dark spine; 4-C very minute and rather inconspicuous; 5, 6-C weak and short; 5-C single or double, about 0.5 of 6-C; usually double, its length usually not reaching beyond the anterior margin of frontoclypeus. *Thorax*. Hair 3-P always single and short, about 0.25 of 1 or 2-P; 4-P usually weak and short, from 0.5 to as long as 3-P, rarely longer, 1-4b; 7-P single or double; 8-P single; 14-P double. *Abdomen*. Hairs 6-I, II double; 7-I single; 6-III-VI double or triple; comb scales numerous, usually undifferentiated in size; 2-VIII single. *Siphon*. Moderately long and slender, index about 5; pecten teeth 8-12, distal teeth gradually longer to 4-5 times as long as basal teeth, most distal teeth with 2-3 enlarged basal denticles and about 15 fine distal denticles; siphonal tufts 5-6 pairs (total 10-12) in number, all strong, subequal, closely spaced and inserted more or less ventrally, the first 2-3 tufts at least 2 times as long as siphonal width at point of insertion, each tuft usually 5-6b; median caudal filament of spiracular apparatus present and well developed. *Anal segment*. Ventral brush with 6 pairs of hairs (total 12).

DISCUSSION. The *mochthogenes* group is the largest and most diverse in the subgenus. The most up to date records include a total of 38 nominal species, of which 10 are from the Ethiopian, 26 from the Oriental, 1 from the Papuan part of the Australasian and 1 from the South Pacific. In the previous study (Sirivanakarn 1971), only 33 nominal forms were listed and assigned to 8 different subgroups. The other 5 species which were not listed are 4 Ethiopian and 1 Oriental. All of these species are placed in the 8 subgroups of Sirivanakarn (loc. cit.) as follows: (1) *hinglungensis* subgroup with *hinglungensis*, *culonicus*, *tricornis* and *cataractarum*; (2) *uncinatus* subgroup with *uncinatus*; (3) *inconspicuus* subgroup with *inconspicuus*, *simpliciforceps*,

castor, *hamoni*, *mijanae*, *orstom*, *fimbriforceps*, *helenae*, *quintetti*, *ngangae* and *bokorensis*; (4) *malayi* subgroup with *malayi*, *laureli* and *yeageri*; (5) *castrensis* subgroup with *castrensis*, *foliatus*, *latifolius*, *chiyutoi* and *shrivastavii*; (6) *femineus* subgroup with *femineus*; (7) *otachati* subgroup with *otachati* and (8) *tenuipalpis* subgroup with *tenuipalpis*, *hayashii*, *hackeri*, *pluvialis*, *kiriensis*, *selai*, *campilunati*, *okinawae*, *lini*, *khazani*, *iphis* and *richei*.

In the Oriental region, the following changes have been made in the taxonomy of the group: *culionicus* Delfinado (1966) is synonymized with *hinglungensis* Chu (1957); *tricontus* Delfinado (1966) is synonymized with *cataractarum* Edwards (1923); *chiyutoi* Baisas (1935) and *shrivastavii* Wattal, Kalra and Khrishnan (1966) are synonymized with *foliatus* Brug (1932); *lini* Lien (1968) is synonymized with *okinawae* Bohart (1953) and *baisasi* is described as a new species. In summary, 23 species are here considered as valid taxa for the entire region. In addition, an unnamed form which is known only in the pupal and larval stages is also placed in the group as sp. 28. The 23 Oriental species are rearranged and certain changes in the previous scheme of internal classification (Sirivanakarn loc. cit.) are being made as follows: (1) removing *castrensis* from *castrensis* subgroup to *hinglungensis* subgroup; (2) recognizing *foliatus* as a new subgroup to replace *castrensis* subgroup; (3) recognizing *bokorensis* subgroup for *bokorensis* to separate it from the Ethiopian species in the *inconspicuous* subgroup and (4) subdividing *tenuipalpis* subgroup into 5 distinct subgroups (*pluvialis*, *khazani*, *tenuipalpis*, *okinawae* and *iphis*). These realignment and detailed subdivisions are primarily based on the male terminalia and secondarily on the type of decumbent scales on the vertex and the plumosity of the flagellar whorls of the male antenna. This new scheme consisting of 11 subgroups is as follows: (1) *uncinatus* subgroup with *uncinatus*; (2) *foliatus* subgroup with *foliatus* and *latifolius*; (3) *hinglungensis* subgroup with *hinglungensis*, *castrensis*, *cataractarum* and *baisasi*; (4) *malayi* subgroup with *malayi*, *laureli* and *yeageri*; (5) *pluvialis* subgroup with *pluvialis*, *campilunati* and *selai*; (6) *khazani* subgroup with *khazani*; (7) *tenuipalpis* subgroup with *tenuipalpis*, *richei*, *hayashii*, *hackeri* and *kiriensis*; (8) *okinawae* subgroup with *okinawae*; (9) *iphis* subgroup with *iphis*; (10) *bokorensis* subgroup with *bokorensis* and (11) *otachati* subgroup with *otachati*.

Five of the 11 subgroups (*foliatus*, *hinglungensis*, *malayi*, *pluvialis* and *tenuipalpis*) may well be considered as complexes of species with similar male terminalia but show subtle differences in the details of the phallosome, basimere, setae of the subapical lobe, distimere and other external adult characters. For a complete characterization and further discussion, see the treatment of individual subgroups.

The majority of the *mochthogenes* species are strongly differentiated from the other groups of *Eumelanomyia* by having male palpus as short as in the female. The only exceptions are *tenuipalpis*, *richei*, *hayashii* and *okinawae* which exhibit a longer male palpus ranging from 0.5-0.75 of the proboscis length. This feature apparently overlaps with species in the *protomelanconion* group. In spite of this the 4 mentioned species essentially conform to the *mochthogenes* group characters and undoubtedly belong to this group. Among the 11 subgroups, the *uncinatus* subgroup is clearly differentiated from all others in the absence of a minor whorl of short hairs in the male antennal flagellum and in the type of the male phallosome. The *foliatus* and *hinglungensis* subgroups are rather related and appear to form a single lineage. The *tenuipalpis* subgroup shows more generalized features than any other subgroup and appears to be most primitive as it contains species with short and long male palpi. On the basis of the male morphology and the known immature stages, it is most probable that the *tenuipalpis* subgroup is the original stem from which the other 4 subgroups, including particularly: *pluvialis*, *malayi*, *khazani* and *okinawae* were derived. The *uncinatus*, *iphis*, *bokorensis* and *otachati* subgroups, all are monotypic and each apparently forms a distinct lineage.

KEYS TO SUBGROUPS AND SPECIES

FEMALES

(Unknown in *hinglungensis*, *baisasi*, *selai*, *richei*,
bokorensis, *otachati* and sp. 28)

1. Decumbent scales on anterior dorsal margin of vertex broad; scales in central part of vertex broad or narrow. 2
Decumbent scales on anterior dorsal margin and in central part of vertex entirely narrow. 7
- 2(1). Anterior half of scutal disc with a complete row of several acrostichal bristles. 3
Anterior half of scutal disc with a few acrostichal bristles (*uncinatus* subgroup). *uncinatus*
- 3(2). Size very small or minute; wing length usually about 2.0 mm. (*hinglungensis* subgroup, in part). *cataractarum*
Size medium; wing length usually between 2.7-3.0 mm. 4
- 4(3). Central part of vertex with narrow linear decumbent scales. (*pluvialis* subgroup). *pluvialis*, *campilunati*
Central part of vertex with broad ovate decumbent scales (*malayi* subgroup). 5
- 5(4). Cibarial armature with 50-60 fine elongate teeth arranged in a row. (Fig. 7B). *malayi*
Cibarial armature with 30-40 coarser teeth arranged in a row. (Figs. 7D, 9B). 6
- 6(5). Cibarial teeth about 40 in number. (Fig. 7D). *laureli*
Cibarial teeth about 30 in number. (Fig. 9B). *yeageri*
- 7(1). Size very small or minute; wing length between 2.0-2.7 mm. 8
Size medium or large; wing length between 3.0-3.9 mm. 10
- 8(7). Very dark to nearly black; abdominal sterna as dark as or slightly paler than terga. 9
Brown or light brown; abdominal sterna much paler than terga. (*khazani* subgroup). *khazani*
- 9(8). Lower *mep* bristle present. (*hinglungensis* subgroup, in part). *castrensis*
Lower *mep* bristle absent. (*foliatus* subgroup). . *foliatus*, *latifoliatus*
- 10(7). Labial basal setae short, about 0.5 of palpal length; size large, wing length 3.9 mm. (*iphis* subgroup). *iphis*
Labial basal setae as long as or longer than palpus; size medium, wing length about 3.0 mm. (*tenuipalpis* and *okinawae* subgroups). 11
- 11(10). Cibarial teeth poorly developed, middle part of cibarial bar with 12 minute teeth; lateral 4-6 teeth coarse and apically truncate. (Fig. 14D). *kiriensis*
Cibarial teeth very well developed, 50 or more teeth present, all narrow, fine, elongate and equal in size. 12
- 12(11). Cibarial armature with 60-90 fine teeth arranged in row. (Figs. 10D, 14B). 13

- Cibarial armature with about 50 teeth arranged in row. (Figs 12C, 15B). *hayashii*, *okinawae*
- 13(12). Cibarial teeth about 60 in number (Fig. 10D). *tenuipalpis*
Cibarial teeth about 90 in number (Fig. 14B). *hackeri*

MALES
(Unknown in sp. 28)

1. Palpus about 0.2 of proboscis. 5
Palpus about 0.5-0.75 of proboscis. 2
- 2(1). Normal flagellar whorls of antenna weakly plumose, with 15-25 hairs; basimere and distimere of terminalia abnormally large (Fig. 15A) (*okinawae* subgroup). *okinawae*
Normal flagellar whorls of antenna strongly plumose, with 30-40 hairs; basimere and distimere of terminalia small and slender (*tenuipalpis* subgroup, in part). 3
- 3(2). Basimere with or without 1 strong submarginal seta. 4
Basimere with a linear row of 4 submarginal setae (Fig. 12A). *richei*
- 4(3). Basal half of distimere with 2-4 fine setae on dorsal surface; lateral plate of phallosome with about 20 strong denticles (Fig. 10C); abdominal terga usually with pale basal bands. *tenuipalpis*
Basal half of distimere without any setae; lateral plate of phallosome with about 7-10 strong denticles (Fig. 12B); abdominal terga entirely dark. *hayashii*
- 5(1). Normal flagellar whorls weakly plumose, with 10-25 hairs. . . . 6
Normal flagellar whorls strongly plumose, with 30-40 hairs. . . . 16
- 6(5). Antennal flagellomeres 1-11 without minor whorls of short hairs; lateral plate of phallosome with a strong internal process (Fig. 4A) (*uncinatus* subgroup). *uncinatus*
Antennal flagellomeres 1-11 with minor whorls of short hairs; lateral plate of phallosome without internal process. 7
- 7(6). Basimere strongly swollen basally; sack-like in shape; distimere sharply angulate at middle dorsally (Fig. 17A) (*bokorensis* subgroup). *bokorensis*
Basimere slender, conical, or slightly modified; distimere sickle-shaped or modified, but not as above. 8
- 8(7). Inner tergal surface of basimere lightly swollen, with a patch of several weak and strong setae; tergum of segment IX with a prominent median lobe bearing several strong setae and a linear row of 7-8 weak setae on each side (Fig. 10B) (*khazani* subgroup). *khazani*
Inner tergal surface of basimere not swollen, with or without strong submarginal setae in row; tergum of segment IX with only two small lateral lobes bearing 2-4 setae. 9
- 9(8). Basimere with a linear row of 6-7 flattened, striated submarginal setae; subapical lobe with setae clearly divided into proximal and distal divisions (Fig. 15C) (*iphis* subgroup). *iphis*
Basimere without row of strong submarginal setae; subapical lobe with setae in proximal and distal divisions closely packed together. 10

- 10(9). Lateral plate of phallosome dark, rodlike, with 6-7 large teeth on lateral margin, ventral sternal lobe very broad and prominent (Fig. 17B) (*otachati* subgroup). *otachati*
Lateral plate of phallosome pale, oval or tapered towards apex, with several small denticles restricted to upper tergal surface; ventral sternal lobe very poorly developed or small. 11
- 11(10). Distimere short and irregular in shape, 3-4 tiny setae present on mid-dorsal surface; distal division of subapical lobe with a close-set row of 5-6 strong bladelike setae; paraproct of proctiger with a small basal sternal process (Figs. 4B, D) (*foliatus* subgroup). 12
Distimere short or long, sickle-shaped or slightly modified, mid-dorsal surface without any setae; distal division of subapical lobe with 1-3 hairlike and 2-5 pointed bladelike setae; paraproct of proctiger without basal sternal process (Figs. 6A-D) (*hinglungensis* subgroup). 13
- 12(11). Three proximal rods of subapical lobe stout, one forming an elbow at middle; lateral plate of phallosome with denticles restricted to tergal surface (Fig. 4B). *foliatus*
Three proximal rods of subapical lobe slender, all straight; lateral plate of phallosome with denticles on tergal surface and on tergal bridge (Fig. 4D). *latifoliatus*
- 13(11). Distal division of subapical lobe with 5 broad, acute lanceolate setae which are serrated subapically; lateral plate of phallosome with several strong denticles (Fig. 6C). *baisasi*
Distal division of subapical lobe with 2-3 hairlike setae only or also with a few pointed simple bladelike setae in addition; lateral plate of phallosome simple or with only a few very weak denticles. 14
- 14(13). Distal division of subapical lobe with 2-3 hairlike setae only, proximal rods long and very slender; lateral plate of phallosome with or without a few weak denticles (Fig. 6B). *cataractarum*
Distal division of subapical lobe with 1-2 hairlike setae and 2-3 narrow pointed bladelike setae, proximal rods short and moderately stout; lateral plate of phallosome without any denticles. 15
- 15(14). Distimere claw slender, long and placed subapically; proctiger crown with some flat and blunt spicules mixed with fine spinelike spicules (Fig. 6A). *hinglungensis*
Distimere claw stout, short and placed apically; proctiger crown with fine spinelike spicules only (Fig. 6D). *castrensis*
- 16(5). Distimere furcate distally into a dorsal and a ventral arm (Figs. 7A, C and 9A) (*malayi* subgroup). 17
Distimere simple, sickle-shaped. 19
- 17(16). Leaflet in distal division of subapical lobe bulbous basally, attenuate distally; submarginal setae absent (Fig. 7C). *laureli*
Leaflet in distal division of subapical lobe broad, spatulate or oblong; submarginal setae present. 18
- 18(17). Leaflet in distal division of subapical lobe spatulate (as in fig. 7a); submarginal setae flattened, and striated. *malayi*
Leaflet in distal division of subapical lobe broad, oblong (as in fig. 9A); submarginal setae strong but not flattened or striated. *yeageri*

- 19(16). Basimere with a linear row of 4-7 strong submarginal setae; distal division of subapical lobe with 1 external and 2 narrow internal leaflets (*pluvialis* subgroup). 20
 Basimere with or without 1 strong submarginal seta; distal division of subapical lobe with a narrow external leaflet and 4-5 narrow blade-like setae (*tenuipalpis* subgroup, in part). 22
- 20(19). Apex of basimere with a clump of 6-7 strong setae sternally. (Fig. 9D). *camfilunati*
 Apex of basimere with 1 or 2 strong setae sternally. 21
- 21(20). Lateral plate of phallosome elongate and tapered distally into a pointed apex, denticles fine and numerous; basimere with 4-5 submarginal setae (Fig. 9C). *pluvialis*
 Lateral plate of phallosome short, tapered distally into a blunt apex, 5-7 strong denticles present; basimere with 5-7 submarginal setae (Fig. 10A). *selai*
- 22(19). Lateral plate of phallosome broad oval or subspherical in shape (Fig. 14A). *hackeri*
 Lateral plate of phallosome distally tapered into a pointed or blunt apex (Fig. 14C). *kiriensis*

PUPAE

(Unknown in *uncinatus*, *hinglungensis*, *castrensis*, *cataractarum*, *pluvialis*, *camfilunati*, *selai*, *khazani*, *richei*, *hackeri*, *ijhis*, *bokorensis* and *otachati*)

1. Hair 10-C 3-5b or more. 2
 Hair 10-C double. 4
- 2(1). Hairs 6-III-VI triple; 5-V triple. sp. 28
 Hairs 6-III-VI 4-6b; 5-V double (Fig. 8A) (*malayi* subgroup). 3
- 3(2). Hairs 6-III-VI usually 4b (4-5); 5-IV 4b. *malayi*
 Hairs 6-III-VI usually 5-6b; 5-IV 5-6b. *laureli* and *yeageri*
- 4(1). Hair 8-C 3-4b; hair 11-C single. *baisasi*
 Hair 8-C single or double, hair 11-C double. 5
- 5(4). Hair 8-C single or with 1 long and 1 short branch; hairs 5-V, VI 3-4b (*tenuipalpis* subgroup, in part). *kiriensis*
 Hair 8-C double, both branches equally long; hairs 5-V, VI double. 6
- 6(5). Hair 5-IV double; 4-VIII double (Fig. 5A) (*foliatus* subgroup).
latifoliatus, *foliatus*
 Hair 5-IV usually 3-4b (2-4); 4-VIII single. 7
- 7(6). Hair 7-C single (Fig. 16A) (*okinawae* subgroup). *okinawae*
 Hair 7-C double (*tenuipalpis* subgroup). 8
- 8(7). Hairs 6-III-VI 4b; hair 5-IV triple (Fig. 13A). *hayashii*
 Hairs 6-III-VI double; hair 5-IV double (Fig. 11A). *tenuipalpis*

LARVAE

(Unknown in *uncinatus*, *hinglungensis*, *castrensis*,
cataractarum, *baisasi*, *pluvialis*, *campilumati*,
selai, *richei*, *hackeri*, *kiriensis*, *iphis*,
bokorensis and *otachati*)

1. Hair 4-P strong and long, of the same magnitude as hairs 1 and 2-P;
hair 3-P triple. 2
Hair 4-P weak, minute, as long as or shorter than 3-P; hair 3-P
single. 3
- 2(1). Hair 4-P triple; 5, 6-C strong, reaching beyond anterior margin of
frontoclypeus; siphonal tufts subventral, all short, about as long as
siphon width at points of insertion (*khazani* subgroup). *khazani*
Hair 4-P single; 5, 6-C weak, their length not reaching beyond anterior
margin of frontoclypeus; siphonal tufts ventral, first 3-4 tufts strong,
about 2-3 times as long as siphonal width at points of insertion.
sp. 28
- 3(1). Abdominal segment VIII with a few large spine-like comb scales mixed
with several small, evenly fringed ones; hair 4-P as strong as 3-P
(Fig. 8B) (*malayi* subgroup). 4
Abdominal segment VIII with small, evenly fringed comb scales only;
hair 4-P shorter than 3-P or rather inconspicuous. 5
- 4(3). Head capsule with striking pattern of dark and pale areas; siphon usually
with dark median band. *laureli*, *yeageri*
Head capsule uniformly pale; siphon usually without dark band as above.
malayi
- 5(3). Hair 4-P 4b; rather small larva (Fig. 5B) (*foliatus* subgroup).
foliatus, *latifolius*
Hair 4-P double; medium sized larva. 6
- 6(5). Hairs 6-III-VI double. 7
Hairs 6-III-VI 3-4b (Fig. 13B) (*tenuipalpis* subgroup, in part). . *hayashii*
- 7(6). Siphon strongly tapered and curved upwards distally; first 3-4 siphonal
tuft 4-5 times as long as siphon width at point of insertion (Fig. 11B)
(*tenuipalpis* subgroup, in part). *tenuipalpis*
Siphon slightly tapered and straight distally; first 3-4 siphonal tufts 2-3
times as long as siphonal width at points of insertion (Fig. 16B)
(*okinawae* subgroup). *okinawae*

uncinatus subgroup

This subgroup is monotypic with a single species, *uncinatus* Delfinado 1966. It was established by Sirivanakarn (1971) on the basis of the key characters and is more completely characterized here under the description of this species. It differs from all other *mochthogenes* species in the complete absence of minor whorls distal to normal whorls in flagellomeres 1-11 of the male antenna and in the presence of a strong internal process in the lateral plate of the male phallosome. The latter feature is somewhat reminiscent of the *mammilifer* group of *Lophoceraomyia* but because it shows several *mochthogenes* characters, I am therefore placing it with this group of *Eumelanomyia*. The immature stages are still unknown and in the distribution this species has been recorded only from Samar in the Philippines.

5. *Culex (Eumelanomyia) uncinatus*
(Fig. 4A, ♂ terminalia)

Culex (Mochthogenes) uncinatus Delfinado 1966, Mem. Amer. Ent. Inst.
7: 134 (♂, ♀).

Culex (Eumelanomyia) uncinatus, Sirivanakarn 1971, Contrib. Amer. Ent.
Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.2 mm.; fore femur 1.4 mm.; proboscis 1.7 mm. Rather small, pale brown species. *Head.* Vertex with numerous broad, small decumbent scales forming a distinct ocular line anteriorly; decumbent scales in center of vertex and on occiput narrow and fine; lateral patch of broad pale scales anteriorly, dark posteriorly; palpus slender, about 0.13 of proboscis length; labial basal setae of proboscis about as long as palpus. *Thorax.* Integument of scutum and scutellum brown, all scales narrow, moderately dense, same color as integument, acrostichal bristles sparse, only 2-3 pairs present on anterior half of scutal disc; pleuron slightly paler than scutum, upper corner of *stt* with a few pale translucent scales; lower *mep* bristle absent. *Legs.* Coxae very pale; anterior surface of hindfemur with a pale stripe extending from base to near apex. *Wing.* Scales on veins R_2 and R_3 narrow, dark and rather dense. *Abdomen.* Terga entirely dark; sterna slightly paler.

MALE. In general as described for female. *Head.* Palpus 0.2 of proboscis length; labial basal setae weak, about 0.5 of palpus; flagellar whorls of antenna weakly plumose, minor whorls absent, normal whorls with 8-10 hairs which are as long as 5 flagellomeres. *Terminalia* (Fig. 4A). Tergal lobe of segment IX small, with 3-4 moderately strong setae; basimere stout, roughly conical, lateral tergal surface with several strong bristles, tergo-mesal margin with a row of 6-7 short setae; proximal division of subapical lobe with 2 slender, apically hooked rods and 1 slender, pointed rod; distal division with 1 apically blunt and 1 pointed blade-like seta and 3-4 hair-like setae; distimere well sclerotized, evenly curved, ventral seta strong, claw short, pointed, placed apically; dorsal subapical seta minute, present or absent; lateral plate of phallosome with a strong internal process which is about 0.5 of external process, external process broad in middle, tapered to a blunt apex distally, denticles practically absent; proctiger crown medium to rather large in size, with several coarse and fine spicules, lateral paraproct without basal sternal process, 4 cercal setae present.

PUPA AND LARVA. Unknown.

TYPE DATA. Holotype: male (684.19) with terminalia slide, Osmena, Samar, PHILIPPINES, May 1945, Rozeboom, Knight and Laffoon (USNM); paratypes: 2 ♂ (684.20, 684.21) and 1 ♀ (684.22) same data as holotype (USNM).

DISTRIBUTION. Known only from the type locality.

TAXONOMIC DISCUSSION. The above description of *uncinatus* is based on a study of the material in the type series originally described by Delfinado (1966). The male terminalia agrees well with the description and figure by this author except for the absence of the basal sternal process in the lateral paraproct of the proctiger. The association of the female with the typical male is presumptive only but appears to be correct as they are essentially similar in external features. The female of *uncinatus* can be readily separated from the other species in the *mochthogenes* group by the presence of fewer acrostichal bristles on the scutal disc, the absence of a lower mesepimeral bristle, and in the male by the complete absence of minor whorls on the antennal flagellomeres and details of the terminalia as indicated in the keys and as in the above description. Because of the distinctive male terminalia, *uncinatus* is recognized as a distinct subgroup separated from other *mochthogenes* subgroups. Its affinity with other species is not clear and can not be resolved until the immature stages are known. The male terminalia are rather similar to the *mammilifer* group of *Lophoceraomyia* but the general adult

characters resemble all other members of the *mochthogenes* group so closely that it seems best to be placed with the latter for the present.

BIOLOGY. The adults of *uncinatus* were collected from a coconut shell, but their associated immature stages were not preserved. No further data is available.

foliatus subgroup

FEMALE. Very small or minute species, wing length 1.9-2.7 mm. *Head.* Decumbent scales on anterior dorsal margin of vertex narrow, linear or clavate, decumbent scales in center of vertex narrow, fine and entirely pale or yellowish brown; palpus very thin and short, between 0.17-0.2 of proboscis length; labial basal setae strong, dark, as long as or longer than palpus. *Thorax.* Acrostichal bristles present; pleuron dark upper half, paler on lower half; lower *mep* bristle absent. *Abdomen.* Terga entirely dark scaled; sterna slightly paler or as dark as terga.

MALE. In general similar to female except for the following. *Head.* Palpus about 0.2 of proboscis length; labial basal setae 0.5 of palpal length; proboscis without clearly marked false joint; normal flagellar whorls of antenna with 15-20 hairs which are moderately long. *Terminalia.* Tergal lobe of segment IX very small, bearing 3-5 tiny hair-like setae; basimere small, more or less conical; subapical lobe with 3 stout or slender rod-like setae proximally and 5-6 broad blade-like setae distally, leaflet absent; distimere rather short, irregular in shape, mid-dorsal surface with 3-4 setae, subapical claw stout and short; lateral plate of phallosome very broad in middle, distally tapered into a blunt apex, denticles strong, varied in number; proctiger crown small, dark, consisting of 4-5 flat and blunt spicules laterally and several fine pointed spicules mesally, lateral paraproct with a small basal sternal process.

PUPA. Abdomen 1.7-2.0 mm, paddle 0.40-0.54 mm, trumpet 0.4-0.52 mm, index 10. In general very pale or creamy white except for dark brown trumpet; the following hairs are diagnostic. *Cephalothorax* and *Metanotum.* Hairs 8-10-C double. *Abdomen.* Most hairs rather weak; hairs 5-IV, V double; 4-VIII double.

LARVA. Head 0.60-0.64 mm, siphon 0.91-1.0 mm, index 7-8, siphon/saddle ratio 4-5. In general very pale and without striking color pattern. *Head.* Antennal shaft predominantly pale, proximal 0.75 with several fine spicules; hairs 5, 6-C very weak and short, 6-C about 0.5 of antennal length, 5-C reduced to 0.5 of 6-C, both hairs double. *Thorax.* Hair 3-P 0.25 of the length of 1 or 2-P, always single; 4-P minute, considerably shorter than 3-P, triple or 4b. *Abdomen.* Hairs 6-III-VI usually triple (2-4); all comb scales small and with even fringes of fine spicules apically; siphon entirely pale, yellowish white and rather slender, distally lightly tapered.

DISCUSSION. The *foliatus* subgroup is recognized here to replace the *castrensis* subgroup in the previous scheme of Sirivanakarn (1971). The *foliatus* subgroup in the present sense includes only *foliatus* Brug 1932 and *latifoliatus* Delfinadi 1966. The other 2 nominal forms: *chiyutoi* Baisas 1935 and *shri-vastavii* Wattal, Kalra and Khrishnan 1966 which were assigned to the *castrensis* subgroup in the previous scheme (Sirivanakarn loc. cit.) are considered as synonyms of *foliatus*. The 2 included species: *foliatus* and *latifoliatus* are closely similar in all stages, but can be distinguished from each other in the male terminalia as indicated in the key and as in the descriptions below.

The *foliatus* subgroup apparently shows a strong affinity with the members of the *hinglungensis* subgroup. These 2 subgroups show a great deal of overlap in general adult characters but are, however, separable from each other by the differences in the shape of the distimere, setae of the subapical lobe and in the phallosome of the male terminalia. The pupa and larva of the *foliatus* subgroup show a great deal of similarity to the *tenuipalpis* and *okinawae* subgroups in many features of the chaetotaxy but are distinct from the *malayi* subgroup in the type of comb scales. Both stages are generally distinguished from the other 3 subgroups by the relatively small size and by the branching of certain hairs as

indicated in the keys and as in the above descriptions.

The breeding habitats of the members of the *foliatus* subgroup are small ground pools in the vicinity of streams under heavy shade of tropical forest. This subgroup appears to be widely distributed throughout Southeast Asia and adjacent areas, but at present it has been definitely recorded only from India, Ceylon, Andaman Islands, Thailand, Vietnam, Hong Kong, Malaysia, Indonesia (only Java) and the Philippines.

6. *Culex (Eumelanomyia) foliatus* Brug
(Figs. 4B, ♂ terminalia; 4C, ♀ cibarial armature;
5A, pupa; 5B, larva)

- Culex (Culex) castrensis* var. *foliatus* Brug 1932, Bull. ent. Res. 23: 82 (♂*, P*, L*); Peter and Dewar 1956, Indian J. Malar. 10: 37-51 (♂*);
Culex (Mochthogenes) chiyutoi Baisas 1935, Philipp. J. Sci. 57: 176 (♂*, ♀); Bohart 1945, U. S. Navmed 580: 73 (♂*); Delfinado 1966, Mem. Amer. Ent. Inst. 7: 129 (♂*). Synonymy with *Culex (Mochthogenes) foliatus* by Bram 1967, Contrib. Amer. Ent. Inst. 2: 34.
Culex (Mochthogenes) shrivastavii Wattal, Kalra and Kh Krishnan 1966, Bull. Indian Soc. Malar. Comm. Dis. 3: 159 (♂*). NEW SYNONYM.
Culex (Mochthogenes) foliatus, Bram 1967, Contrib. Amer. Ent. Inst. 2: 34 (♂*, ♀, L*);
Culex (Eumelanomyia) foliatus, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.0-2.7 mm, fore femur 1.0-1.4 mm, proboscis 1.2-1.44 mm, abdomen 1.3-1.5 mm. Small, very dark to black species. *Head.* Decumbent scales on dorsum of vertex narrow and fine, predominantly pale yellowish; lateral patch of broad scales dingy or bluish white; erect scales slender, numerous and entirely dark; palpus very short, about 0.17 of proboscis length; proboscis with 4 labial basal setae, 2 lateral ones as long as palpus; antenna longer than proboscis by about the length of the terminal segment. *Cibarial armature* (Fig. 4C). Cibarial bar with about 24 teeth, 14 middle teeth very narrow and apically pointed, 7-9 lateral teeth coarser, apically truncated or abruptly pointed. *Thorax.* Scutal integument black; scutal scales narrow and predominantly dark; acrostichal bristles present; dorsocentral very strong and dark; pronotum and upper part of pleuron as dark as scutum; lower part of pleuron pale greenish; *hpl* with 1 strong and 3-4 weak setae; lower *mep* bristle absent. *Legs.* All coxae very pale greenish; anterior surface of hind femur with a pale white stripe extending from base to near apex; all tibiae and tarsi dark to black scaled. *Wing.* Scales on veins R_2 , R_3 and R_{4+5} narrow and fine. *Abdomen.* Terga entirely black scaled; sterna slightly paler or sometimes as dark as terga.

MALE. In general as in female, with the following distinctive features. *Head.* Palpus about 0.2 of proboscis length; proboscis rather thin, false joint absent, labial basal setae very weak, short, hairlike; normal flagellar whorls weakly plumose, with about 20 hairs, minor whorls with 7-8 short hairs. *Terminalia* (Fig. 4B). Tergum IX with poorly developed tergal lobe, bearing 3-4 short and weak setae; sternum IX broad, rectangular and practically bare; basimere very small, conical, about 0.14 mm in length, inner tergal surface without strong submarginal setae; subapical lobe broad, not projecting, proximal division with 3 rodlike setae of which 1 is swollen, strongly curved, forming an elbow at middle, 2 other rods thin, more or less straight, distal division with a row of 5-6 broad bladelike setae which are pointed or blunt apically, leaflet absent; distimere short, about 0.5 of basimere in length, basal half swollen dorsally, distal half lightly tapered into a blunt or truncate apex, subapical claw stout and short, mid-dorsal surface with 3-4 tiny setae; phallosome oval shaped, apical half of lateral plate tapered into a blunt tip, inner tergal surface with 7-8 strong and 4-6 weak denticles, upper part of tergal bridge with or without fine spicules; proctiger crown small, with 3-4 flat and blunt and

several fine and pointed spicules, lateral paraprocess with a short basal sternal process and a small apical lobe, cercal setae 3 or 4 in number.

PUPA (Fig. 5A). Abdomen 1.7-1.9 mm, paddle 0.40-0.46 mm, trumpet 0.4 mm, index about 10. Pigmentation entirely yellowish white except for darkened areas on antenna, leg and wing cases; trumpet dark, nearly uniformly cylindrical except for slightly widened pinna, pinna with a short slit extending to meatus; chaetotaxy as figured, the following hairs are diagnostic. *Cephalothorax* and *Metanotum*. Hair 8-C double; 9-C usually double, rarely single; 10 and 11-C double. *Abdomen*. Hairs 5-IV-VI double; 1-III-VII usually 5 or 6(4-7), 7(5-9), 6(4-7), 3 and 2 or 3b respectively; 6-III-VI usually 2(2-3), 3(2-4), 3(2-3) and 3(1-3)b respectively; hair 2-VII always internal to 1-VII; 9-VII very short and weak, 2b; 4-VIII single or double; 9-VIII 4 or 5b, placed very near to caudolateral angle. *Paddle*. Paler than abdomen; external buttress weakly sclerotized; external distal margin practically smooth or provided with a few number of minute spicules; midrib very weak and pale; hairs 1 and 2-P present.

LARVA (Fig. 5B). Head 0.6 mm, siphon 0.9-1.0 mm, index 7-8, saddle 0.26 mm, siphon/saddle ratio 4-5. Pigmentation variable from pale white entirely to partially dark or bluish green on head, thorax and abdomen. *Head*. Antennal shaft dark at extreme base, creamy white in the middle and lightly darkened beyond hair 1-A; hairs 2 and 3-A subapical; hair 1-C a dark, moderately stout spine; hairs 4, 5 and 6-C close together, 4-C minute and rather inconspicuous; 5-C very weak and short, about 0.6 of 6-C in length, double; 6-C double, its length not reaching beyond anterior margin of frontoclypeus; 7-C with 4-6 pectinated branches; 13-C double; 14-C double; 16, 17-C present as minute spicules; mentum with a large median tooth and 6 lateral teeth on each side. *Thorax*. Unspiculated; hairs 1-3-P single, 3-P about 0.25 of 1 or 2-P; 4-P minute, considerably shorter than 3-P, usually 3 or 4b; 7-P usually double (1-2); 8-P single; 14-P double; 3-M double; 4-M 2-4b; 8-M 3, 4b; 9-M 4b; 7-T 4-6b; 9-T 4b. *Abdomen*. Unspiculated; most hairs very weakly developed; hairs 6-I, II double; 7-I single; 6-II-VI usually 3(3-4), 3(3-4), 3 and 3(2-3)b respectively; hairs 1-III-VI usually 4b(3-5); 1-VII 6b(5-7); 4-VII single; comb scales 30-40 in number, aggregating in 3 or 4 rows, all scales with even apical fringes of fine spicules. *Siphon*. Entirely pale yellowish and moderately long, distally slightly tapered; pecten teeth 8-10 in number, distal teeth 4-5 times as long as basal teeth, denticles 18-19 in number; subventral tufts strong, 5-6 pairs in number, 4-5b each, first 4 tufts about twice as long as siphon width at point of attachment, most distal tuft shortest, about 1.5 of or as long as siphon width; median caudal filament very well developed. *Anal segment*. Hair 2-X with 1 short and 1 long branch; ventral brush consists of 6 pairs of hairs, all inserted within grid; anal gills very slender, 1.0-1.5 of the length of saddle.

TYPE DATA. (1) *Culex* (C.) *castrensis* var. *foliatus* Brug 1932, holotype: male with terminalia mounted on plastic slip attached to pin, Bandung, Java INDONESIA, July 1929, S. L. Brug (BM). (2) *Culex* (M.) *chiyutoi* Baisas 1935, lectotype: male with slide of terminalia, Kolambagan, Lanao, Mindanao, PHILIPPINES (USNM); SELECTION OF BRAM (1967: 37). (3) *Culex* (M.) *shrivastavii* Wattal, Kalra and Khrishnan 1966, holotype: male, Ferrar Ganj, ANDAMAN ISLANDS, 27 V 1965, Bhola Ram (National Institute of Communicable Disease, Delhi, India).

DISTRIBUTION. Material examined: 175♂, 156♀, 55 P, 71 L; 226 with associated skins (182 p, 44 lp).

ANDAMAN ISLANDS. *Jarkatang*, 2♂.

THAILAND. *Mae Hong Son*: Ban Mae Tia; Doi Chang; Ban Hua Yang; 2♂, 1 P, 2 lp. *Chiang Mai*: Doi Sute; Chiang Dao; 3♂, 3♀, 2 P, 2 L, 2 p, 1 lp. *Lampang*: Ampur Tern; Ban Pha Daeng; Ban Pang Paka; 5♂, 8♀, 2 P, 2 L, 5 p, 7 lp. *Nan*: Ban Wang Mo, 1 P. *Phrae*: Ban Noi Rong Nok, 1 P. *Tak*: Huey Lan Saeng, 6♂, 6♀, 12 p. *Nakhon Ratchasima*: Pak Chong; Muak Lek; Ban Tha Ma Prang; Khlong Pai; Khao Suan Hom; 7♂, 9♀, 1 P, 7 p, 1 lp. *Nakhon Nayok*: Huey Sai Noi; Khao Sing To; 2♂, 2♀, 2 P, 2 L, 1 p, 2 lp.

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Kanchanaburi: Huey Mae Nam Noi, 2 P, 2 L. *Chon Buri*: Siracha, Bang Phra, 1♂, 1 lp. *Chantaburi*: Ban Tha Mai; Ban Bang Phu; Khao Sai Dao; 14♂, 26♀, 29 P, 3 L, 31 p, 4 lp. *Trat*: Koh Chang, Ban Salak Pet; Khao Yai Yai; Khao Chang Yai; 7♂, 11♀, 15 p. *Prachuap Khiri Khan*: Tub Sakae, 1♀. *Ranong*: Khlong Set Takuat; Khao Hin Chang; 2♂, 1♀, 3 p. *Fhangnga*: Nam Tai, 1♂, 1♀, 1 p. *Krabi*: Ban Mai Kien Tai; Khao Aopong; 1♂, 1♀, 1 p. *Phuket*: Khao Chang Yai; Khao Prathin; Ban Huey Luk; 38♂, 15♀, 49 p, 4 lp. *Songkhla*: Boripat Water Fall; Tone Nga Chang Water Fall; 11♂, 9♀, 5 P, 15 p, 2 lp. *Yala*: Yala Bong, 9♂, 1♀, 8 p, 2 lp. *Narathiwat*: Khau Lau, 9♂, 21♀, 4 P, 24 p, 5 lp.

S. VIETNAM. *Danang*, 1 L.

HONG KONG. *Sai Tung* District, 2♂, 3♀, 3 p, 2 lp.

TAIWAN. *Tung Shi*, 1♀, 6 L.

MALAYSIA. *East Malaysia*: *Pahang* - Pulau Tioman; Gunong Benom; Chegar Perah; 30♂, 29♀, 3 P, 27 L, 5 p, 10 lp. *West Malaysia*: *Sarawak* - Tebangan, 1♂. *Sabah* Kudat; Jesselton; 2♂, 1♀.

INDONESIA. *Java*: Bandung, 2♂.

PHILIPPINES. *Luzon*: Subic Bay; Subic Naval Base; Dingalam Bay, Tayabas; 4♂, 7♀, 6 L, 4 lp. *Mindoro*: San Jose, 14 L. *Palawan*: Iwahig; Puerto Princesa; 2 L. *Samar*: Osmena, 3 P, 3 L. *Leyte*: Lago Lago Baybay, 6♂. *Mindanao*: Lanao, Kolambugan; Parang; 8♂.

Additional records from the literature: NEPAL; INDIA; CEYLON (Peter and Dewar 1956); CHINA, *Hainan Island* (Chu 1957); INDONESIA, *Alor* (Brug and Bonne-Wepster 1947).

TAXONOMIC DISCUSSION. I have checked the type and other topotypic material of *foliatus* Brug 1932 from Java against the type of *castrensis* Edwards 1922 from India and definitely agree with Bram (1967) in elevating it to a full species instead of a variety of the latter as done by Brug. I also agree with Bram (loc. cit.) in treating *chiyutoi* Baisas 1935 from the Philippines as a synonym of this species on the basis of similarity in the male terminalia and larval stage. In addition, I am also synonymizing *shrivastavii* Wattal, Kalra and Krishnan 1966 from the Andaman Islands with *foliatus* based on the comparison of the type specimen by Dr. B. L. Wattal in India. The 2 topotypic males of *shrivastavii* which were kindly sent to us by Dr. B. L. Wattal for confirmation are essentially similar to *foliatus*, leaving no doubt that both forms are conspecific.

C. foliatus is one of the most common and widely spread species in Southeast Asia and adjacent areas. Its range of distribution extends to the northwest in Nepal and India, to the west in Ceylon and Andaman Islands, to the north to China, Hongkong and Taiwan, to the east to the Philippines and to the south to Java and Alor, Indonesia. There is no significant variation in the diagnostic characters of all stages of *foliatus* and all specimens which I have examined from several localities essentially conform to a single type. It can be readily recognized in the male by (1) setae of the subapical lobe and (2) shape and other features of the distimere of the terminalia; in the female by (1) narrow, linear decumbent scales on the dorsum of vertex, (2) absence of lower mesepimeral bristle and (3) cibarial teeth; in the pupa by (1) double branching of hair 8-C and (2) double branching of hairs 5-IV-VI; and in the larva by (1) minute prothoracic hair 4-P which is 3-4-branched, (2) undifferentiated comb scales and (3) pale siphon and its strong subventral tufts.

BIOLOGY. The breeding habitats of *foliatus* are usually small ground pools at stream margins or in the middle of dried up streams. On certain occasions, the immature stages have also been found in rock pools and foot prints. These habitats were under heavy shade of tropical forest at an altitude ranging from about sea level to 900 meters or more. The adults were collected while resting on branches or leaves of tree seedlings and shrubs near their breeding sites. Although *foliatus* is very common, it has never been reported to attack man or other animals in nature.

7. *Culex (Eumelanomyia) latifolius* Delfinado
(Fig. 4D, ♂ terminalia)

Culex (Mochthogenes) latifolius Delfinado 1966, Mem. Amer. Ent. Inst. 7: 131 (♂*, ♀).

Culex (Eumelanomyia) latifolius, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.7 mm, fore femur 1.33 mm, proboscis 1.6 mm. Extremely similar to *folius*, differing in the following features. *Head.* Decumbent scales on dorsal anterior ocular line of vertex coarser, clavate; decumbent scales in center of vertex and occiput fewer and apparently coarser; lateral patch of broad appressed scales darker. *Cibarial armature.* Not studied.

MALE. Differing from *folius* as in the female and in the following additional features. *Head.* Normal flagellar whorls of antenna more strongly plumose. *Terminalia* (Fig. 4D). Very similar to *folius* except as follows: proximal division of subapical lobe with 3 rodlike setae which are more slender, subequal in length and more or less straight; lateral plate of phallosome with more numerous strong denticles, upper part of tergal bridge with several fine, but distinct spicules; lateral paraproc with a more distinct basal sternal process.

PUPA. Abdomen 2.0 mm, paddle 0.54 mm, trumpet 0.52 mm, index 10. Essentially as described and figured for *folius*, differing only in the following. *Abdomen.* Hair 6-III triple; 6-IV, V 4b; 9-VII stronger, triple.

LARVA. Head 0.64 mm, siphon 1.0 mm, index 7, siphon/saddle ratio about 4. As described and figured for *folius*, differing chiefly in the following. *Head.* Hair 5-C stronger, about 0.75 of the length of hair 6-C; 6-C longer, reaching anterior margin of frontoclypeus. *Thorax.* Hair 7-P always double. *Abdomen.* Hairs 1-IV, V 5-6b; 1-VII 7b.

TYPE DATA. Holotype: male with slide of terminalia, Malawin Creek, College, Laguna, Luzon, PHILIPPINES, 18 January 1935, F. E. Baisas (USNM).

DISTRIBUTION. Known only from the Philippines. Material examined: 12♂, 1♀, 8 L; 2 with associated larval and pupal skins.

PHILIPPINES. Luzon: College, Laguna, Malawin Creek; Mt. Makiling; 3♂. Mindoro: San Jose, 5♂, 8 L. Palawan: Balshahan River, 4 mi inland; Cabayugan, Marble Mountain; Panitan; 4♂, 1♀, 2 lp.

TAXONOMIC DISCUSSION. *C. latifolius* is endemic to the Philippines where it has been found only in Luzon, Mindoro and Palawan. It is probably more widely distributed than the present records show. In the islands where it occurs it was found to be sympatric with *folius*. This species is very closely related to *folius* from which it can be distinguished in the adult by the coarser decumbent scales on the vertex and by the slender, more or less straight rodlike setae in the subapical lobe of the male terminalia. The pupa and larva are described from a few reared specimens. Both stages show a great deal of overlap in general and in the detailed chaetotaxy with *folius* except for a few characters as indicated in the keys and in the above diagnosis. There is apparently no overlap in the diagnostic features of the male terminalia between *latifolius* and *folius* and since both forms are sympatric, I am convinced that they are specifically distinct.

The above description of the adults of *latifolius* is similar to that by Delfinado (1966: 131) except for the absence of a lower mesepimeral bristle. The female designated as allotype by Delfinado (loc. cit.) is incorrect as this specimen has the vertex entirely covered with broad scales and a lower mesepimeral bristle. It appears most probable that this female belongs to *laureli* or *yeageri*.

BIOLOGY. The breeding sites of *latifolius* include ground pools and rock pools near stream or creek under heavy shade of forest. In one case the immatures were collected from a puddle in an open rice field. The adults were

also caught while resting among vegetation near their breeding site. Adult biology is not known.

hinglungensis subgroup

FEMALE. Minute species; wing length about 2.0 mm. In general very similar to *foliatus* subgroup, differing in the following features. *Head.* Decumbent scales on anterior dorsal margin of vertex varied from predominantly broad to narrow clavate; decumbent scales in center of vertex broad and dark or sometimes narrow, linear and yellowish brown; palpus more slender and shorter, about 0.12-0.13 of proboscis length. *Thorax.* Pleuron uniformly pale or sometimes dark on upper half, paler below; lower *met* bristle usually present, sometimes absent. *Abdomen.* Terga and sterna usually entirely dark scaled, sterna sometimes paler than terga.

MALE. In general as described for female. *Head.* Normal flagellar whorls of antenna with 7-12 hairs which are rather weak and short. *Terminalia.* Basimere very small, conical; subapical lobe with 3 slender and short rodlike setae proximally and a variable number of narrow, pointed blades distally, the latter are sometimes replaced by hairlike setae; leaflet absent; distimere typically sickle-shaped, sometimes slightly modified, mid-dorsal surface without any setae; terminal claw small, usually subapical, sometimes apical; lateral plate of phallosome small, distally tapered to a blunt apex, denticles usually completely absent, sometimes present; proctiger crown very small with only a few coarse and fine spicules, sometimes of medium size with several spicules; lateral paraproct without basal sternal process.

PUPA (*baisasi* only). In general as described for *foliatus* subgroup, differing particularly in the following. *Cephalothorax* and *Metanotum*. Hairs 8-C triple, 9, 10-C double. *Abdomen.* Hair 5-IV single.

LARVA. Unknown.

DISCUSSION. The *hinglungensis* subgroup was established by Sirivanakarn (1971) to include 4 nominal species: *hinglungensis* Chu 1957, *culionicus* Delfinado 1966, *tricontus* Delfinado 1966 and *cataractarum* Edwards 1923. In the present study, *culionicus* is regarded as a synonym of *hinglungensis* and *tricontus* as a synonym of *cataractarum*. In addition, *castrensis* which was earlier placed in the *castrensis* subgroup is now transferred to this subgroup. An additional species, *baisasi* n. sp. is also placed here, making the total of 4 valid taxa for the whole subgroup. The *hinglungensis* subgroup as characterized above is apparently more heterogeneous than the *foliatus* subgroup. It is clearly differentiated from the latter by the sickle-shaped distimere, setae of the subapical lobe and the absence of a small basal sternal process in the lateral paraproct of the proctiger of the male terminalia. The 4 members in this subgroup are all distinct and can be definitely identified by the differences in the male terminalia. The immature stages are unknown except for the pupa of *baisasi*.

A pupa of *baisasi* was reported to have been collected from an axil of *Colocasia* sp. and another from a rock pool. It appears most likely that the other members in this subgroup are ground pool breeders. This subgroup may contain more species than recognized here. At present, it has been recorded only from Thailand, Cambodia, Hainan Island and the Philippines and from New Britain in the Papuan part of the Australasian region.

8. *Culex (Eumelanomyia) hinglungensis* Chu
(Fig. 6A, ♂ terminalia)

Culex (Mochthogenes) hinglungensis Chu 1957, Acta zool. Sinica, 9: 163 (♂*); Chu 1958, Indian J. Malar. 12: 111 (list); Bram 1967, Contrib. Amer. Ent. Inst. 2: 37 (♂*).

Culex (Mochthogenes) culionicus Delfinado 1966, Mem. Amer. Ent. Inst. 7: 130 (♂*). **NEW SYNONYMY.**

Culex (Eumelanomyia) hinglungensis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Unknown.

MALE. Very small or minute, brown to black species; wing length 1.9 mm. In general as described for the subgroup with the following diagnostic features. *Head*. Decumbent scales on dorsum of vertex broad and predominantly pale forming a distinct ocular line, pale brown posterolaterally; narrow decumbent scales rather few, yellowish brown, restricted to dorsal midline in center and to occiput; erect scales rather few in number, predominantly pale or dark; lateral patch of broad appressed scales brown to dark; palpus very thin and short, about 0.15 of proboscis length; proboscis slender, 6 dark strong labial basal setae present, lateral ones strongest, slightly longer than palpus, false joint absent; antenna as long as proboscis, normal flagellar whorls very weakly plumose, with 10-12 hairs each, minor whorls with 5-6 short hairs; flagellomeres 1-11 with several minute setae in addition. *Thorax*. Acrostichal bristles present, rather weak and short; dorsocentrals strong and dark; pleuron uniformly pale brown, scales practically absent; anterior lower *mep* bristle present. *Legs*. All femora, tibiae and tarsi dark scaled. *Wing*. Plume scales small, narrow, clavate and moderately dense on all veins. *Abdomen*. Terga and sterna entirely dark to black scaled. *Terminalia* (Fig. 6A). Tergal lobe of segment IX very poorly developed, with a linear row of 4-6 short and tiny setae, sternum IX without scales or setae; basimere small, conical, about 0.13 mm in length; subapical lobe directed mesad, proximal division with 3 rodlike setae, 2 of which are stout with truncated apices, 1 thinner with pointed apex, distal division with 1 external basal seta and a mesal group of 1 or 2 fine hair-like and 2 or 3 lanceolate setae; distimere short, sickle-shaped, about 0.5 of the length of basimere; ventral subapical seta present just beyond the midpoint, subapical claw rather long, about 0.25 of the length of distimere; phallosome oval-shaped, very well sclerotized, lateral plate strongly tapered into a point or blunt apex which is slightly hooked, denticles practically absent; proctiger crown small, with 4-5 flat and blunt and a few fine and pointed spicules; lateral paraproct very thin, apical lobe absent or not developed, basal sternal process absent; cercal setae usually 2 in number, sometimes 3 or 4.

PUPA and LARVA. Unknown.

TYPE DATA. (1) *Culex (M.) hinglungensis*, holotype: male, caught in the crevice of rocks near mountain stream, Hing-Lung, Hainan Island, CHINA, May 1954 (Dept. Parasit. Second Military College, China). (2) *Culex (M.) culionicus* Delfinado 1966, holotype: male, San Pedro, Culion Island, Palawan, PHILIPPINES, 26 March 1947, H. Hoogstraal (USNM).

DISTRIBUTION. Material examined: 11 ♂.

THAILAND. *Chiang Mai*: Chiang Dao, 1 ♂.

CAMBODIA. *Kirirom*, 3 ♂.

PHILIPPINES. *Mindoro*: San Jose; Bulacan; 2 ♂. *Palawan*: Culion, San Pedro; Puerto Princesa; 5 ♂.

Additional record from the literature: *Hainan Island* (Type locality), CHINA (Chu 1957).

TAXONOMIC DISCUSSION. I have not seen the type of this species but from checking the male characters with the published description and the figure of *hinglungensis* by Chu (1957) I am convinced that the present interpretation and the assignment of the male specimens listed above to this species is correct. *C. hinglungensis* is apparently widely spread, but at present it is known only from Hainan, China, Thailand, Cambodia and the Philippines. The above synonymy of *culionicus* Delfinado 1966 with *hinglungensis* is based on the comparison between the specimens from the Philippines (as *culionicus*) with those from Thailand and Cambodia (as *hinglungensis*). Both nominal forms resemble each other very closely in the details of the male terminalia indicating that they are undoubtedly conspecific. The Philippine males differ slightly in being paler and in having a few more spicules in the proctiger crown but these differences do not appear to be sufficiently distinct to warrant

their recognition as a separated species.

C. hinglungensis shows a great deal of superficial resemblance to *foliatus* and *latifoliatus* but is clearly separated from the latter two species by (1) having broad scales covering most of the vertex; (2) presence of a lower mesepimeral bristle and (3) several features of the male terminalia as described and as illustrated. It is apparently closely similar to *castrensis* from India and Ceylon, but can be separated from the latter as indicated in the key and as in the description given above.

BIOLOGY. In Hainan, the single type male of *hinglungensis* was caught among rock crevices near a mountain stream (Chu, 1957). The males from Thailand and Cambodia were also collected in mountainous areas. No field data is available for the collection of the specimens (as *culionicus*) from the Philippines. The breeding habitat is unknown.

9. *Culex (Eumelanomyia) castrensis* Edwards
(Fig. 6D, ♂ terminalia)

Culex castrensis Edwards 1922a, Indian J. med. Res. 10: 285 (New name for *Aedes nigrescens* Theobald 1907); Barraud 1924a, Indian J. med. Res. 11: 1280 (♂, ♀).

Aedes nigrescens Theobald 1907, Mon. Cul. 4: 540 (♂, ♀). Preoccupied by *Danielsia nigrescens* Theobald 1907 (Edwards 1922a).

Culex (Mochthogenes) castrensis Edwards 1932, in Wytzman, Genera Insect., fasc. 194: 195 (taxonomy); Barraud 1934, Fauna Brit. India, Diptera, 5: 355 (♂*, ♀).

Culex (Eumelanomyia) castrensis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. A minute and dark species; wing length about 2.0 mm. Essentially as described by Edwards (1922: 285) who was later quoted by Barraud (1924a: 1280) and Barraud (1934: 355) and as in the following. *Head.* Vertex with numerous yellowish pale narrow decumbent scales in the center; erect scales slender and rather fine, predominantly pale; frontal bristle weaker and paler than lateral ocular bristles; palpus about 0.2 of proboscis length; labial basal setae strong and as long as palpus. *Thorax.* Scutal scales fine and predominantly dark except for paler ones on anterior promontory and anterior margin of fossa; acrostichal bristles well developed; pleuron with darkened area in the upper region, paler below; 1 lower *me* bristle present. *Wing.* Scales very narrow and dark. *Abdomen.* Terga entirely dark scaled; sterna paler scaled.

MALE. Wing 1.7 mm, fore femur 0.8 mm, proboscis 1.2 mm. Similar to female in general characters and in relative length of palpus, differing as follows. *Head.* Proboscis without distinct false joint; labium slender in basal half, slightly thicker in apical half; antennal flagellar whorls weakly plumose, normal whorl with about 15 hairs; minor whorls with 4-5 short hairs. *Terminalia* (Fig. 6D). As figured; very small and exceedingly similar to *hinglungensis* except for the following: subapical lobe of basimere with 3 slender rod-like setae in proximal division and 2 narrower flattened acute setae and 2-3 fine hairlike setae in distal division, external basal seta absent; distimere rather distinct in shape, somewhat angled on mid-dorsal surface, terminal claw shorter, placed more or less apically; lateral plate of phallosome strongly diverging towards apex, with or without a few weak denticles; procotiger crown consisting of fine, pointed, spinelike spicules only, 4 cercal setae present.

PUPA AND LARVA. Unknown.

TYPE DATA. Lectotype: male marked as type by Edwards, with attached terminalia mount, Castle Rock, N. Kanara, Bombay, INDIA, 5 April 1902, James (BM). **PRESENT SELECTION.**

DISTRIBUTION. Known only from India and Ceylon. Material examined: 2♂ and 1♀. INDIA. Bombay, N. Kanara, Castle Rock, 1♂, 1♀. CEYLON,

Suduganga, 1♂.

TAXONOMIC DISCUSSION. The above description of *castrensis* is based on a male and a female originally marked as types by Edwards (1922) from India and on a male identified by Edwards from Ceylon. This species is somewhat intermediate between the *foliatus* and *hinglungensis* subgroups. The general adult features resemble *foliatus* but the male terminalia resembles *hinglungensis*. Based on the latter feature, I am now placing *castrensis* with the *hinglungensis* subgroup instead of the *castrensis* subgroup in the previous scheme (Sirivanakarn 1971). It is separated from members of the *foliatus* subgroup in general by the presence of a lower mesepimeral bristle and in the male terminalia by the setae of the subapical lobe, shape of the distimere and lateral plate of phallosome. The male terminalia are extremely similar to *hinglungensis* from which they differ slightly as indicated in the key and in the above diagnosis. It can also be separated from *hinglungensis* most readily by the narrower decumbent scales on the dorsum of the vertex.

BIOLOGY. The breeding habitat of *castrensis* is not known. In the type locality in India, the types were collected in association with the specimens of *C. malayi* (Edwards 1922).

10. *Culex (Eumelanomyia) cataractarum* Edwards
(Fig. 6B, ♂ terminalia)

Culex (Mochthogenes) cataractarum Edwards 1923, Bull. ent. Res. 14: 7 (♂, ♀); Edwards 1932, in Wytsman, Genera Insect. fasc. 194: 195 (taxonomy).

Culex (Mochthogenes) tricontus Delfinado 1966, Mem. Amer. Ent. Inst. 7: 133 (♂*, ♀). NEW SYNONYMY.

Culex (Eumelanomyia) cataractarum, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Very small or minute, dark brown to black species, wing length about 2.1 mm. In general very similar to *hinglungensis*, differing from it in the following features. *Thorax*. Upper corner of *stþ* with a few pale translucent scales; lower *metþ* bristle absent. *Wing*. Plume scales on all veins finer.

MALE. Differing from *hinglungensis* as described for female and as in the following. *Head*. Palpus shorter, about 0.12 of proboscis length; proboscis with 2-4 labial basal setae which are nearly 1.5 times as long as palpus; flagellomeres 1-11 of antenna without minute setae in addition to normal and minor whorls of longer hairs. *Terminalia* (Fig. 6B). Tergal lobe of segment IX very poorly developed, bearing 2-3 tiny setae; basimere larger and longer, about 0.15 mm in length, lateral tergal surface with fewer and weaker bristles; subapical lobe smaller, proximal division with 3 rather longer, rodlike setae, distal division with 1 tiny and 1 strong hairlike seta; distimere sickle-shaped, more slender and longer, about 0.75 of the length of basimere, apical half tapered into a recurved truncate apex, ventral subapical seta present, subapical claw narrow and rather long; phallosome oval shaped, lateral plate slightly tapered into a broad blunt or rounded apex, denticles absent or only a few present, proctiger crown with 4-5 fine spinelike spicules; cercal setae 2-3 in number.

PUPA and LARVA. Unknown.

TYPE DATA. (1) *Culex (M.) cataractarum* Edwards 1923, Lectotype: male, marked as type by Edwards, with attached terminalia mount, on rocks near water fall, Rabaul, New Britain, BISMARCK ARCHIPELAGO, 1922, G. F. Hill (BM); PRESENT SELECTION. (2) *Culex (M.) tricontus* Delfinado 1966, holotype: male, Malawin Creek, College, Laguna, Luzon, PHILIPPINES, 18 January 1935, F. E. Baisas (USNM).

DISTRIBUTION. Presumably widely spread, but at present, *cataractarum* has been recorded only from the Philippines and New Britain, Bismarck Archipelago. Material examined: 5♂ and 1♀. PHILIPPINES, Luzon, 1♂. BISMARCK ARCHIPELAGO, New Britain, Rabaul (type locality), 4♂, 1♀.

TAXONOMIC DISCUSSION. *C. cataractarum* was described from 4 males and 1 female from Rabaul, New Britain, Bismarck Archipelago, but no illustration was provided. The male characters agree very well with the original description by Edwards (1923). The above synonymy of *tricontus* Delfinado (1966) from the Philippines with *cataractarum* is based on the similarity in several features of the male terminalia and other conspicuous external characters. The Philippine male differs from the typical form in being paler and in having a few weak denticles on the lateral plate of the phallosome, but these differences are not sufficiently distinct to warrant its recognition as a separate species. On the basis of the present records, it appears most likely that *cataractarum* is widely distributed on the chain of islands which connect the Philippines, New Guinea and the Bismarck Archipelago.

C. cataractarum is closely similar to *hinglungensis* from which it is distinguished in the male by (1) absence of lower mesepimeral bristle; (2) larger and longer basimere and distimere and (3) setae of the subapical lobe and (4) shape of the phallosome as described and illustrated.

BIOLOGY. The specimens in the type series of this species were collected among rocks near a water fall indicating that it is probably a ground pool breeder. The single male from the Philippines was reported to have been collected from a creek, presumably by sweeping with net over vegetation. The biology of adults is unknown.

11. *Culex (Eumelanomyia) baisasi* n. sp.
(Fig. 6C, ♂ terminalia)

FEMALE. Unknown.

MALE. In general very similar to other members of the *hinglungensis* subgroup in small size and weakly plumose antennal flagellar whorls, differing in the combination of following features. *Head.* Decumbent scales in center of vertex narrow, broad decumbent scales restricted to eye margin, forming a very narrow pale ocular line; erect scales predominantly dark centrally, pale yellowish posterolaterally; palpus very thin and short, about 0.15 of proboscis; 4-6 labial basal setae present, longest ones as long as palpus; flagellar whorls of antenna apparently more weakly plumose, normal whorls with 7-9 hairs, minor whorls with 4-5 hairs. *Thorax.* One lower *mep* bristle present. *Legs.* Anterior surface of hind femur with pale stripe from base to near apex. *Terminalia* (Fig. 6C). Tergal lobe of segment IX very poorly developed, 2-3 tiny setae present, rather inconspicuous; subapical lobe most distinctive, proximal division with 3 subequal rodlike setae which are rather short, all with truncate apices, distal division with a strong basal seta laterally and a mesal group of 5 broad lanceolate setae, 3 of which are serrated along subapical margin; distimere typically sickle-shaped, ventral subapical seta rather strong, subapical claw relatively small and short; lateral plate of phallosome tapered to a blunt apex, denticles present, strong, 12 in number, arranged in two close rows on upper tergal surface; proctiger crown with 4-5 coarse and 6-7 fine spine-like spicules, 2 cercal setae present.

PUPA. In general as figured for *foliatus* (Fig. 5A) to which it is very similar in size, pigmentation and in features of trumpet, differing apparently in the following. *Cephalothorax* and *Metanotum*. Hair 8-C 3-4b. *Abdomen*. Hairs 1-III-V 5, 4 and 2b respectively; 5-IV single; 6-III-V all single.

LARVA. Unknown.

TYPE DATA. Holotype: male (C1 103-2) with associated pupal skin and terminalia slide, axil of *Colocasia* sp., Kolambugan, Lanao, Mindanao, PHILIPPINES, 10 December 1965, M. Santiago (USNM); 1 paratype male (791.50) with terminalia and antenna slide, rockhole above stream level, Osmena, Samar, PHILIPPINES, 19 July 1945, Johnson, Knight and Laffoon (USNM). This species is named after Dr. F. E. Baisas in recognition of his contribution to the knowledge of the Philippine mosquitoes.

DISTRIBUTION. Known only from Mindanao and Samar in the Philippines. Material examined: 2♂ as indicated in the type data.

TAXONOMIC DISCUSSION. *C. baisasi* apparently falls into the *hinglungensis* subgroup on the basis of the shape of the distimere and details of the subapical lobe of the basimere of the male terminalia. The lateral plate of the phallosome and the texture of the decumbent scales on the vertex of *baisasi* are, however, rather similar to the *foliatus* subgroup. As in *C. castrensis*, this species is also somewhat intermediate between the 2 mentioned subgroups, suggesting that it is probably of hybrid origin between the 2 subgroups. It is distinguished in the male as indicated in the key and in the above diagnosis. The pupa is described from a single specimen associated with the male type and can be readily recognized from other known forms by the key characters and by the above description.

BIOLOGY. The specimens of *baisasi* were reported to have been collected from 2 different types of habitats, once from leaf axil of *Colocasia* and once from a rockhole. The biology of the adults is unknown.

malayi subgroup

FEMALE. Small species, wing length between 2.3-2.7 mm. *Head.* Anterior dorsal margin and central part of vertex clothed with broad decumbent scales; narrow scales restricted to occiput; palpus varies from 0.1-0.2 of the length of proboscis; labial basal setae as long as palpus. *Thorax.* Acrostichal bristles very well developed; 1 lower *met* bristle present. *Abdomen.* Terga usually entirely dark, rarely with narrow pale basal or apical bands; sterna as dark as or slightly paler than terga.

MALE. In general similar to female except for the following. *Head.* Palpus about 0.2 of proboscis length; normal flagellar whorls strongly and densely plumose, number of hairs varies from 30-40; proboscis usually with a false joint marked by a weak flexion just beyond the middle. *Terminalia* Tergal lobe of segment IX poorly developed, 2-3 tiny setae present; basimere with or without a linear row of 6-7 strong, flattened submarginal setae on inner tergal surface; subapical lobe clearly divided into proximal and distal divisions; leaflet of distal division present, shape varied; distimere furcates at the middle into two arms; lateral plate of phallosome distally narrowed, terminating in a blunt apex, several denticles present; proctiger crown moderate in size with a few coarse and several fine spicules.

PUPA. Abdomen 1.7-2.2 mm. Paddle 0.5-0.52 mm. Trumpet 0.38-0.52 mm, Index 8-9. In general as described for the group, with the following characteristic hairs. *Cephalothorax* and *Metanotum*. Hair 8-C usually 4b, rarely triple; 9-C double; 10-C 4-6b. *Abdomen.* Hair 5-IV 3-6b; hairs 5-V, VI double; 6-III-VI 4-6b.

LARVA. Head 0.6-0.65 mm. Siphon 0.85-0.9 mm, index 7-10, siphon/saddle ratio 3-4. In general conforms to the description of the group, the following characters are diagnostic. *Head.* Hair 5-C 0.25-0.5 of the length of hair 6-C. *Thorax.* Hair 4-P as long as 3-P, triple or 4b. *Abdomen.* Segment VIII with some enlarged comb scales mixed with several small, apically fringed scales; siphon usually with dark median ring, sometimes absent and entirely pale.

DISCUSSION. The *malayi* subgroup includes 3 very closely related species: *malayi* (Leicester 1908), *laureli* Baisas 1935 and *yeageri* Baisas 1935. They are extremely similar in all stages and are recognized primarily by the differences in the shape of the leaflet of the subapical lobe. This subgroup is strongly differentiated from the other subgroups by the furcation of distimere of the male terminalia, the branching of metanotal hair 10-C in the pupa, the magnitude of hair 4-P and the presence of some enlarged comb scales in the larva. In the general characters of the adults, the members of this subgroup overlap with members of the *pluvialis* subgroup, particularly in the broad decumbent scales of the vertex and in the strong plumosity of male antennal flagellar whorls. The male terminalia also show some resemblance in the phallosome and in the subapical lobe to those of the *pluvialis* subgroup to which they are probably related.

All members of the *malayi* subgroup are ground pool breeders. *C. malayi* and *laureli* are rather common in the areas in which they occur and have been frequently found in large number in a given collection. The subgroup is very widely spread within Southeast Asia and adjacent areas and appears to extend its range towards the East as far as New Guinea, and to the North in the southern part of mainland China. Within Southeast Asia, it has been reported from every country except the Ryukyu Islands.

12. *Culex (Eumelanomyia) malayi* (Leicester)
(Figs. 7A, ♂ terminalia; 7B, ♀ cibarial armature;
8A, pupa; 8B, larva)

- Aedes malayi* Leicester 1908, Cul. Malaya 3: 184 (♂, ♀).
Aedes nigrescens Theobald 1907, Mon. Cul. 4: 540 (♂, ♀). Preoccupied by
Danielsia nigrescens Theobald 1907 (Edwards 1922b).
Aioretomyia aedes Leicester 1908, Cul. Malaya 3: 189 (♂).
Culex (Micraedes) malayi, Edwards 1917, Bull. ent. Res. 7: 228 (taxonomy);
1922a, Bull. ent. Res. 13: 92 (♂).
Culex malayi, Barraud 1924a, Indian J. med. Res. 11: 1282 (♂); Barraud
and Covell 1928, Indian J. med. Res. 15: 671 (♀ buccopharyngeal arma-
ture); Borel 1926, Arch. Inst. Pasteur Indo-Chine 3-4: 43 (♂*, ♀, L*);
Borel 1930, Mon. Coll. Soc. Path. exot. 3: 368 (♂*, ♀, L*);
Culex (Mochthogenes) malayi, Edwards 1930, Bull. ent. Res. 21: 305 (taxono-
my); 1932, in Wytzman, Genera Insect., fasc. 194: 195 (taxonomy);
Barraud 1934, Fauna Brit. India, Diptera 5: 358 (♂*, ♀, L); Li and Wu
1935, Yearbook Bur. Ent. Chekiang 4: 98 (L*); Brug 1939, Tijdschr.
Ent. 82: 111 (L*); Lee 1944, Atlas Mosq. Larvae, Australasian Region
:90 (L*); Carter and Wijesundara 1948, Ceylon J. Sci. (B) 23: 143
(distribution); Galliard and Ngu 1949, Ann. Parasit. 24: 502 (♂*, L*);
Bonne-Wepster 1954, Roy. trop. Inst. Amst. Spec. Pub. 111: 111
(♂, ♀, L*); Hsieh and Liao 1956, Acta ent. Sinica 6: 376 (L*); Lien 1962,
Pacif. Insec. 4: 631 (distribution); Bram 1967, Contrib. Amer. Ent.
Inst. 2: 39 (♂*, ♀, L*);
Culex (Eumelanomyia) malayi, Sirivanakarn 1971, Contrib. Amer. Ent. Inst.
7: 62-85 (taxonomy).

FEMALE. Wing 2.4 mm, fore femur 1.2 mm, proboscis 1.4 mm, abdo-
men 1.4-1.7 mm. In general small, dark to black species. *Head.* Vertex
clothed with broad decumbent scales which are whitish or grayish on ocular
line and predominantly dark or black posteriorly; narrow decumbent scales
restricted to occiput; erect scales slender and entirely dark; palpus 0.1 to 0.2
of proboscis length, apparently 3-segmented; proboscis with 4 dark labial basal
setae, the longest ones as long as palpus. *Cibarial armature* (Fig. 7B). As
figured; very distinctive; cibarial bar with 60-70 teeth, middle one narrow and
fine, lateral ones coarser. *Thorax.* Scutum, scutellum and pronotum brown,
reared specimens dark greenish; scutal scales moderately dense, as dark as
integument; acrostichal bristles well developed; dorsocentrals very strong and
dark; pleuron usually with striking pattern of dark and lighter areas; scales
practically absent; 1 anterior lower *mep* bristle present. *Legs.* Coxae very
pale; anterior surface of hind femur with a pale stripe along the whole length;
tibiae and tarsi very dark to black scaled; pulvilli very well developed. *Wing.*
Plume scales narrow, very dark and moderately dense on all veins; halter knob
dark scaled, stem pale and bare. *Abdomen.* Terga usually entirely dark to
black scaled, sometimes with basolateral pale spots or basal pale bands on
terga II-VII.

MALE. Essentially as described for the female except for the following.
Head. Broad decumbent scales on vertex predominantly pale, forming a distinct
ocular line anteriorly; erect scales yellowish brown to dark brown; palpus
usually 0.2 of proboscis length; proboscis with false joint which is marked by
a slight flexion at 0.6-0.7 of the length from base; labial basal setae weaker,

all subequal; flagellar whorls of antenna densely long plumose; normal whorls with 35-40 long hairs; minor whorls with 5-8 short hairs. *Wing*. Scales scantier than in female. *Terminalia* (Fig. 7A). Segment IX with small tergal lobes which bear 2-3 weak and short setae each; sternum IX thin and broad, without any setae or scales; basimere roughly oval or conical, with several strong setae laterally, inner tergal surface with a striking row of 6-7 strong, flattened and striated submarginal setae, all subequal in length and acuminate at tips; subapical lobe mesal in position, proximal and distal divisions clearly separated; proximal division with 3 slender subequal rods, 1 with hooked apex, the other 2 tapered to a point apically; distal division with lateral group of 1 strong basal seta and 1 very large spatulate leaflet and a mesal group of 1 fine hair-like seta and 2 narrow blade-like setae one of which is fringed with a few spicules subapically; distimere strongly modified, distal half divided into a dorsal arm which bears 1 tiny subapical seta and a longer ventral arm which bears a slender subapical claw; phallosome oval-shaped, lateral plate tapered to a blunt point distally, 6-7 denticles present, poorly or well developed, all restricted to upper tergal surface; proctiger crown medium sized, with a few coarse and several fine and pointed spicules; paraproct with a small apical lobe, basal sternal process absent; 1 or 2 cercal setae present.

PUPA (Fig. 8A). Abdomen 1.7-2.0 mm, paddle 0.5 mm, trumpet 0.38-0.47 mm, index 8-9. In general, very pale yellowish or cream colored except for cases of leg, wing, antenna, proboscis and palpus which are darkened. Trumpet dark, moderately long and uniformly cylindrical, pinna with slit extending to meatus; chaetotaxy as figured, the following are diagnostic. *Cephalothorax* and *Metanotum*. Hair 8-C usually 4b(3-4); 9-C single; 10-C 4 or 5b, sometimes more; 11-C double. *Abdomen*. Hair 5-IV usually 4b(3-5); 5-V, VI double; 6-III-VI usually 4-5b(3-7); minute hair 2-VII usually laterad of 1-VII, sometimes mesad to the latter; 9-VII usually triple (2-3); 4-VIII usually triple (3-4); 9-VIII usually 5 or 6b(4-6), pectinate. *Paddle*. Midrib weak; apical hairs 1, 2-P present.

LARVA (Fig. 8B). Head 0.6 mm, siphon 0.85-0.9 mm, index 7, saddle 0.3 mm, siphon/saddle ratio 3-4. As figured, in general similar to *foliatus*, differing particularly in the following features. *Head*. Anterior part of ocular bulge with a striking white band contrasting sharply with other darkened areas of head capsule; hair 5-C usually double, sometimes triple; 6-C double, about twice as long as 5-C; 7-C strongly plumose, 8-10b; 13-C 3 or 4b. *Thorax*. Hair 4-P as long as 3-P, or sometimes longer, 3-4b; 7-P double; 8-P single. *Abdomen*. Hairs 1-III-VI 5-6b; 1-VII 9-10b; comb scales strongly differentiated, 18-23 in number, anterior scale small with apical fringe of fine spicules, posterior scales larger and longer, terminating in a median stout spine-like spicule and with a lateral fringe of fine spicules. *Siphon*. Rather thicker, median dark band usually absent, sometimes present; siphonal tufts always 6 pairs (total 12) in number, each 6-8b. *Anal segment*. Ventral brush consists of 6 pairs of hairs, 1 or 2 of which are detached from grid; anal gills slender and as long as saddle.

TYPE DATA. (1) *Aedes malayi* Leicester, lectotype: male with slide of terminalia, pools, Circular Road, Kuala Lumpur, *Selangor, West Malaysia, MALAYSIA*, October 1903, G. F. Leicester (BM); **SELECTION OF BRAM** (1967: 42). (2) *Aedes nigrescens* Theobald, holotype: male with attached terminalia mount, Castle Rock, *Bombay, INDIA* (BM). (3) *Aioretomyia aedes* Leicester, holotype: male with attached terminalia mount, Kuala Lumpur, *Selangor, West Malaysia, MALAYSIA*, G. F. Leicester (BM).

DISTRIBUTION. Widely spread in Southeast Asia except in the Philippines. The records from Halmahera, New Guinea and other areas in the eastern part of Indonesia by Brug and Bonne-Wepster (1947) are doubtful as they could refer to *laureli* which is dominant and widely spread in the Philippines. In addition to the distribution data below, the records from Ceylon, Nepal, Maldive Islands and Andaman Islands as noted by Stone, Knight and Starcke (1959) and Bram (1967) are probably valid. Material examined: 225♂, 228♀, 25P, 8L, 393 with associated skins (233p, 60lp).

- INDIA. *Bombay*: N. Kanara, Kavar, 3♂, 2♀. *Bengal*: Calcutta, 1♂.
Bihar: Janapur, 1♂, 1♀.
 CEYLON. *Ratnapura*, Uggalkaltota; *Vavuniya*, Parayanalankulam;
Anuradhapura, Hunuwilagama; 1♂, 2♀.
 CHINA. *Shanghai*, 5♂, 15♀. *Kiangsi*, 1♂.
 HONG KONG. 1♂, 1♀.
 THAILAND. *Chiang Mai*: Chang Phuck; Ban Chang Khien; Chiang Dao;
 Doi Saket; 20♂, 7♀, 10 p. *Lampang*: Ngao; Ban Pha Daeng; Ban Rong; Ban
 Bang Pako; Ban Rong Na; Ban Huey Khien; 45♂, 45♀, 2 P, 52 p, 12 lp. *Nan*:
 Ban Sala; Ban Pang Mon; Ban Fang Minh; Ban Phuang Chom Phu; Pha Daeng
 Khawi; 17♂, 23♀, 15 P, 35 p, 2 lp. *Khon Kaen*: Phu Wiang, 1♂, 1 p.
Nakhon Ratchasima: Khlong Phai; Ban Kae Chae; Ban Salatdi; 4♀, 4 p.
Prachin Buri: Ban Thap Lan; Ban Bu Phram; 12♂, 15♀, 2 p, 7 lp. *Phet Buri*:
 Tha Yang; Gang Ga Jarn; Wat Sammarong; 13♂, 5 L, 1 lp. *Chon Buri*: Bang
 La Mung, Khao Mai Keaw; Siracha, Bang Phra; Ban Laem Sing; 3♂, 2♀, 2 p,
 1 lp. *Prachuap Khiri Khan*: Khlong Huai Sai; Khlong Hin Chaung; 12♂, 9♀, 21 p.
Ranong: Khlong Set Takuat; Khao Hin Chang; 12♂, 3♀, 14 p, 1 lp. *Krabi*:
 Ban Mai Kaen Tai; Khlong Thom; Khao Aopong; Ban Sai Thai; 27♂, 27♀, 32 p,
 12 lp. *Phangnga*: Khao Pak Chaung; Pathum; Nam Tai; 1♂, 5♀, 4 p, 1 lp.
Phuket: Ban Khian, 1♀, 1 p. *Surat Thani*: Koh Samui, Bang Makham, 1♀, 1 lp.
Nakhon Si Thammarat: Chaung Khao, 2♂, 1♀, 3 p. *Songkhla*: Boripat Water
 Fall, 1 P, 1 L. *Satun*: Khuan Ga Long, 24♂, 49♀, 7 P, 2 L, 46 p, 18 lp.
 S. VIETNAM. *Gia Dinh*; *Con Son*; *Long Khanh*; 5♂, 4♀.
 MALAYSIA. *West Malaysia*: *Kelantan*, Gua Musang, 7♂, 7♀, 3 p, 2 lp.
Perak, Kg. Jalong, 1♂, 1♀. *Kedah*, Sintok Forest Reserve, 3♂, 3♀, 3 p, 2 lp.
East Malaysia: *Sabah*, Kudat; *Tombolugu Tuaran*; *Keningau*; 3♂.
 INDONESIA. *Sumatra*: *Mandailing*; *Maeora Tebo*; 4♂.
 Additional records from the literature: INDIA, *Assam*; ANDAMAN
 ISLANDS (Barraud 1934); CHINA, *Hainan Island* (Chu 1958); TAIWAN (Lien
 1962); INDONESIA, *Java*, *Celebes*, *Kabaena*, *Sangir Island*, *Halmaheira*,
West Irian, *Sumbar* and *Timor* (Brug and Bonne-Wepster 1947; Bonne-
 Wepster 1954).

TAXONOMIC DISCUSSION. *C. malayi* is one of the most common species of *Eumelanomyia* in Southeast Asia and adjacent areas except in the Philippines where it appears to be completely replaced by the other 2 closely similar species: *laureli* and *yeageri*. The adults can be identified in general by the broad dusky decumbent scales on the vertex and in the male by the densely long plumose antennal flagellum and the presence of a clearly marked false joint just distad of the middle of the proboscis. The male terminalia are characterized by the furcation of the distimere, the presence of strong, flattened submarginal setae on the inner tergal surface of basimere and the shape of the leaflet of the subapical lobe. The pupa is distinguished by hair 8-C which is 3-4 branched and hair 10-C which is 4-5 branched. The larva is recognized by the presence of some enlarged comb scales and by the magnitude and branching of hair 4-P as indicated in the key and in the above diagnosis.

Except for the male terminalia and other diagnostic features, *malayi* adults show a great deal of variation in size, coloration, texture of scutal scales and in the presence or absence of basal pale bands or basolateral pale spots on the abdominal terga. The female cibarial armature is variable in the number and length of teeth. The specimens from China differ conspicuously from the typical form in the south, e. g. Malaya and Thailand, in being larger (wing length 3.0 mm or more), paler coloration, having coarser scutal scales, presence of basal pale bands on abdominal terga II-VII and in the presence of fewer and shorter cibarial teeth. However, since these differences are not correlated with any differentiation in the male terminalia, they are considered as conspecific.

C. malayi can be readily separated from *laureli* and *yeageri* from the Philippines by details of the male terminalia as indicated in the key as described above. The topotypic female of *malayi* is also strikingly different from the other 2 species in the presence of more numerous cibarial teeth.

The pupa and larva are extremely similar to those of *laureli* and *yeageri* except for certain hair branchings as given in the keys.

BIOLOGY. *C. malayi* is a common forest species and has been reported to utilize ground pools as the principal breeding habitat. In Thailand, the immature stages have been found mainly in pools near stream margins under heavy shade of the forest (Bram 1967: 42). The present records also include rock pools, ponds, ditches and crab holes. They were frequently collected in association with specimens of *Lophoceraomyia* and on occasion also with those of *foliatus*. Adult biology is not known and it appears that *malayi* is of no direct medical importance to man.

13. *Culex (Eumelanomyia) laureli* Baisas
(Figs. 7C, ♂ terminalia; 7D, ♀ cibarial armature)

Culex (Mochthogenes) laureli Baisas 1935, Philipp. J. Sci. 57: 176 (♂*);
Synonymy with *Culex (M.) malayi* by Bohart 1945, U. S. Navmed 580: 73;
resurrected from synonymy by Delfinado 1966, Mem. Amer. Ent. Inst.
7: 132 (♂*, ♀, P, L*).

Culex (Eumelanomyia) laureli, Sirivanakarn 1971, Contrib. Amer. Ent. Inst.
7: 62-85 (taxonomy).

FEMALE. Wing 2.7 mm, fore femur 1.2 mm, proboscis 1.5 mm abdomen 1.9 mm. In general extremely similar to *malayi*, differing slightly as in the following. **Head.** Anterior midline of vertex with more numerous narrow decumbent scales; broad decumbent scales confined to eye border and to postero-lateral area. **Cibarial armature** (Fig. 7D). Differs from *malayi* in having fewer teeth, about 40 in number, all teeth apparently coarser.

MALE. In general as in female, differing from *malayi* chiefly in the following features of terminalia. **Terminalia** (Fig. 7C). Inner tergal surface of basimere without strong submarginal setae, only very short and weak setae present; distal division of subapical lobe with an asymmetrical leaflet which is broad, somewhat bulbous in basal 0.25, distal 0.75 narrow, rodlike, gradually tapered into a point apically; dorsal arm of distimere with 1 or 2 ventral setae; lateral plate of phallosome with stronger teeth, extending towards lateral margins.

PUPA. Abdomen 2.0-2.2 mm, paddle 0.52 mm, trumpet 0.46 mm, index 7-10. As figured for *C. malayi* (Fig. 8A) to which it is very similar, differing in chaetotaxy as follows: *Cephalothorax*. Hair 8-C usually triple (3-4). **Abdomen.** Hair 5-IV 5 or 6b, rarely 4b; 6-III-VI 5 or 6b; 4-VIII double.

LARVA. Head 0.65 mm, siphon 0.85 mm, index 5-6, saddle 0.26 mm, siphon/saddle ratio 3-4. Essentially as described and figured for *C. malayi* (Fig. 8B), differing slightly in the presence of more striking pattern of dark and light areas on head capsule and in the presence of a median dark band on the siphon.

TYPE DATA. Type: male (Lot R38-xx), Malaybalay, Bukidnon, *Mindanao*, PHILIPPINES, 4 April 1934, F. E. Baisas (formerly in the collection of the Bureau of Health, Manila, Luzon, Philippines). Upon our recent inquiry to Dr. Gemma Cruz Araneta, Director of National Museum and Dr. F. E. Baisas, in Manila, Philippines, we were informed that the type of this species was lost, probably before 1945.

DISTRIBUTION. Widely spread among the major islands in the Philippines. Material examined: 48♂, 14♀, 12 P, 15 L; 14 with associated lp skins.

PHILIPPINES. *Luzon*: Subic Naval Base; San Pablo City; 3♂, 1♀, 2 lp. *Mindoro*: San Jose, 16♂, 6♀, 4 P, 5 L. *Samar*: San Antonio; Osmena; Guirang; Sohoton; 8♂, 6♀, 8 P, 11 L, 12 lp. *Leyte*: Lago Lago Baybay; Tacloban; 9♂. *Palawan*: Puerto Princesa; Iwahig; Batangas; 10♂, 1♀, 1 P, 2 L. *Mindanao*: Lanao, Dansalan; Zamboanga, Mercedes; Quinipot; 8♂.

TAXONOMIC DISCUSSION. *C. laureli* is one of the most common forms of *Eumelanomyia* in the Philippines where it has been found to be widely distributed among several major islands. It is quite possible that it may also

occur on the islands in eastern Indonesia. The records by Bonne-Wepster (1954) from the Celebes, Halmahera and other islands towards New Guinea as *malayi* is rather doubtful as it may well be *laureli*.

C. laureli is extremely closely related to *malayi* from which it can be separated with certainty only in the male terminalia and female cibarial armature as indicated in the keys and as in the above description. There is apparently no overlap in the diagnostic features of the male terminalia between *laureli* and *malayi*, but there is a great deal of overlap in general and in the chaetotaxy of the pupa and larva. The *laureli* pupa can be separated from that of *malayi* by the branching of a few hairs as indicated above, but the larvae are virtually inseparable. It is probable that *laureli* has become differentiated from *malayi* through geographic isolation.

BIOLOGY. As in *malayi*, *laureli* also utilized ground pools as a breeding habitat. The larvae and pupae were collected in numbers from pools in the vicinity of streams, springs or creeks. Nothing is known about adult biology.

14. *Culex (Eumelanomyia) yeageri* Baisas
(Figs. 9A, ♂ terminalia; 9B, ♀ cibarial armature)

Culex (Mochthogenes) yeageri Baisas 1935, Philipp. J. Sci. 57: 175 (♂*); Bohart 1945, U. S. Navmed 580: 74; Delfinado 1966, Mem. Amer. Ent. Inst. 7: 134 (♂*).

Culex (Eumelanomyia) yeageri, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.3 mm. Extremely similar to *malayi* and *laureli*, differing slightly in smaller size and in the following: *Head*. Erect scales on vertex and occiput finer; labial basal setae of proboscis shorter than palpus. *Cibarial armature* (Fig. 9B). Very similar to *laureli*, differing in having fewer teeth which are about 30 in number. *Abdomen*. Terga entirely dark scaled, basolateral spots or basal bands absent.

MALE. Essentially similar to the female except for the presence of narrow apical pale bands on abdominal terga II-VII. *Terminalia* (Fig. 9A). Very similar to *malayi* and *laureli*, differing only in the following: inner tergal surface of basimere with a row of 4-5 strong submarginal setae which are not flattened or striated; subapical lobe with 3-5 long, weak hairs adjacent to bases of proximal rodlike setae, distal division with a symmetrical leaflet which is broad, oblong and acuminate at tip, and 2 simple accessory setae one of which is blade-like and the other one hair-like; distimere and phallosome as in *laureli*.

PUPA. Abdomen 2.0 mm, paddle 0.52 mm, trumpet 0.52 mm. As figured and as described for *malayi* (Fig. 8A) and *laureli*; extremely similar to *laureli*, differing particularly in having abdominal hairs 1-V-VII usually 10(9-10), 5, 4b respectively (usually 6(5-7), 4(3-4) and 2, 3b in *laureli*.)

LARVA. Head 0.62 mm, siphon 0.85 mm, index 5-6, saddle 0.26 mm, siphon/saddle ratio about 3.3. As figured for *malayi* (Fig. 8B) and as described for the latter and *laureli*, apparently indistinguishable from both forms by any feature of chaetotaxy; color of head capsule and siphon as in *laureli*.

TYPE DATA. Type: male (Lot R66-xyz), Iwahig, Palawan, PHILIPPINES, 7 June 1934, F. E. Baisas (in the collection of the Bureau of Health, Manila, Luzon, Philippines). We were informed by Dr. Gemma Cruz Araneta, Director of National Museum and Dr. F. E. Baisas, in Manila, Philippines, that the type and other cotypes of this species were lost, probably before 1945.

DISTRIBUTION. Presumably restricted only to Palawan in the Philippines. Material examined: 12♂, 2♀, 2 P, 4 L; 3 with associated 1p skins.

PHILIPPINES. Palawan: Iwahig; Bacungan; Quezon, Panitan; 12♂, 2♀, 2 P, 4 L, 3 lp.

TAXONOMIC DISCUSSION. *C. yeageri* is known only from Palawan in the Philippines where it was found to occur sympatrically with *laureli*. It appears to be rather rare and is probably endemic to this island. It is very closely

similar to *malayi* and *laureli* from which it differs, however, in the shape of the external leaflet, presence of 3-4 long and fine hairs in the subapical lobe and in the presence of the strong submarginal setae on the inner tergal surface of the basimere of the male terminalia. I have seen only 2 males of *yeageri* which are also quite distinct from *malayi* and *laureli* in the presence of pale apical bands on abdominal terga II-VII. However, as this feature is not shown in the female and because of the limited amount of the male material, it is not possible here to evaluate its diagnostic importance. The female cibarial armature of *yeageri* has fewer teeth than that of *laureli*; the pupa can be separated by the presence of more branches in the abdominal hairs 1-V-VII but the larva is virtually indistinguishable from the latter or *malayi*. As in *laureli*, this species is probably derived from *malayi* through geographical isolation.

BIOLOGY. The breeding site of *yeageri* includes ground pools and rock pools in the vicinity of streams or other small water sources under heavy shade of tropical forest. At present, nothing is known about adult biology.

pluvialis subgroup

FEMALE. Medium sized species, wing length 3.0-3.9 mm. *Head.* Anterior dorsal margin of vertex with broad decumbent scales, scales in center of vertex broad or narrow; palpus about 0.15 of proboscis length. *Thorax.* Acrostichal bristles very well developed; lower *mep* bristle present. *Abdomen.* Terga entirely dark scaled; sterna paler scaled.

MALE. In general as in female. *Head.* Palpus about 0.2 of proboscis length; labial basal setae about 0.5 of palpal length; proboscis without apparent false joint; flagellar whorls densely plumose, normal whorls with 30-35 long hairs. *Terminalia.* Tergal lobe of segment IX with 5-10 moderately strong setae; basimere slender, more or less conical, inner tergal surface with a linear row of 4-7 strong submarginal setae, its apex with 1-7 setae sternally; subapical lobe clearly separated into proximal and distal divisions, proximal division with 3 subequal rods, distal division with 1 strong basal seta and 1 very broad leaflet laterally, 2 hair-like setae and 2 long and broad blades mesally; distimere slender, sickle-shaped; subapical claw short and slender; lateral plate of phallosome tapered to a blunt or pointed apex, denticles numerous, size varied; proctiger crown medium sized, with a few coarse and several fine pointed spicules.

PUPA and LARVA. Unknown.

DISCUSSION. The *pluvialis* subgroup as recognized here includes 3 closely allied species: *pluvialis* Barraud 1924a, *campilunati* Carter and Wijesundara 1948 and *selai* Klein and Sirivanakarn 1969. In the previous scheme (Sirivanakarn 1971), these 3 species were placed in the *tenuipalpis* subgroup, but because of the distinctive male and general adult characters, I am now recognizing them as a separate subgroup. It is distinguished from the *tenuipalpis* subgroup by the predominantly broad decumbent scales on the ocular line of vertex (entirely narrow in *tenuipalpis*), details of the subapical lobe of the basimere and by the shape of lateral plate of the phallosome. On the basis of comparative adult morphology, the *pluvialis* subgroup appears to be more closely related to the *malayi* subgroup than to other subgroups of *mochthogenes*. At present, this subgroup is known only from India, Ceylon, Cambodia and Borneo (East Malaysia).

15. *Culex (Eumelanomyia) pluvialis* Barraud (Fig. 9C, ♂ terminalia)

Culex pluvialis Barraud 1924a, Indian J. med. Res. 11: 1281 (♂*, ♀).

Culex (Mochthogenes) pluvialis, Edwards 1932, in Wytzman, Genera Insect. fasc. 194: 195 (taxonomy); Barraud 1934, Fauna Brit. India, Diptera 5: 356 (♂, ♀).

Culex (Eumelanomyia) pluvialis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. No specimens were available for study. The following measurements are quoted from Barraud (1934: 356). Wing 3.0 mm, palpus 0.21 mm, proboscis 1.3 mm.

MALE. Head. Vertex with broad ovate decumbent scales which are entirely pale to almost white, forming distinct ocular line; decumbent scales in center narrow, yellowish brown; erect scales entirely pale; antennal flagellar whorls densely long plumose, normal whorls with 30 or more hairs. **Thorax.** Scutal integument brown; scales narrow and entirely dark brown; pleuron darkened on *ppl*, *psp*, *ssp*, upper *stp* and *met*, pale below. **Legs.** Anterior surface of hind femur with pale stripe from base to near apex. **Wing.** Scales narrow, rather minute and scanty. **Abdomen.** Terga dark, sterna pale yellowish. **Terminalia** (Fig. 9C). As figured; segment IX with small tergal lobe bearing 5-7 setae; apex of basimere with 1 or 2 setae on sternal surface, inner tergal surface with 4-5 strong submarginal setae in row parallel to tergo-mesal margin; proximal and distal divisions of subapical lobe clearly divided, proximal division with 3 stout and gently curved rods; distal division with 1 strong basal seta and 1 broad acuminate leaflet laterally and a mesal group of 2-3 strong hair-like setae and 2 broad, club-shaped blades or leaflets; distimere slender, sickle-shaped, basal half uniformly thick, apical half narrow, tapered to a slightly recurved, truncate apex, subapical claw slender and short; ventral subapical seta rather strong, placed slightly beyond middle of curvature, dorsal subapical seta absent; lateral plate of phallosome broad in middle, tapered into a blunt point apically, denticles numerous; proctiger crown with a few coarse and several fine spine-like spicules; cercal setae tiny, 1 or 2 in number.

PUPA and LARVA. Unknown.

TYPE DATA. Lectotype: male, Kadra, North Kanara, Bombay, INDIA, reared from larva collected from a small rock pool in heavy jungle, September 1921, P. J. Barraud (BM). **PRESENT SELECTION.**

DISTRIBUTION. Known only from the type locality in India. Material examined: 3♂, as indicated in the type data.

TAXONOMIC DISCUSSION. I have examined 3 males in the type series of this species and found them agreeing well with the description and figure by Barraud (1924a, 1934). *C. pluvialis* shows similarity to *malayi* in general external characters, but is distinct from the latter in having an unmodified sickle-shaped distimere and in other details of the male terminalia. It is very similar to *campilunati* Carter and Wijesundara (1948) from Ceylon and to *selai* Klein and Sirivanakarn (1969) from Cambodia but differs from both slightly in certain features of the male terminalia as indicated in the key and in the above diagnosis.

BIOLOGY. According to Barraud (1924a: 1281-1282), the adult specimens of *pluvialis* were reared from larvae collected in a rock pool in heavy jungle in association with the specimen of *C. malayi*. The biology of the adults is unknown.

16. *Culex (Eumelanomyia) campilunati* Carter and Wijesundara
(Fig. 9D, ♂ terminalia)

Culex (Mochthogenes) campilunati Carter and Wijesundara 1948, Ceylon J. Sci., 23: 143 (♂*, ♀).

Culex (Eumelanomyia) campilunati, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. No specimen is available for this study, the following description is quoted from Carter and Wijesundara (1948: 143). "Head: vertex mainly covered with golden narrow curved and dark brown upright scales, but with some white and dark flat scales laterally, the former extending narrowly some

distance along eye margins. Proboscis, clypeus and palpi dark brown, the latter very short about 1/7th the length of the proboscis. Bucco-pharyngeal armature consisting of a row of numerous slender teeth, those in the centre longer than the others. *Thorax*: mesonotum pale brown or grayish-brown covered with curved golden-brown scales and with brown bristles, those on the posterior portion and over the wing roots being longer and darker; scutellum brown with golden-brown narrow scales, and long dark marginal bristles; pleura pale brown, darker on the upper part of sternopleura and post- and subspiracular areas, one lower mesepimeral bristle present. Legs dark brown, unbanded, the middle and hind femora paler beneath. Wings dark, the plume scales on the upper and lower forks long and rather dense; length 3.5-3.9 mm. Abdomen with the tergites and sternites dark brown, unbanded, the hairs golden-brown. "

MALE. Based only on the single terminalia slide (marked as cotype). *Terminalia* (Fig. 9D). As figured, extremely similar to *pluvialis*, differing particularly in the following features: apex of basimere with a dense group of 6-7 setae on sternal surface, its inner tergal surface with more numerous short hairs extending to the level of subapical lobe; distal division of subapical lobe with broader leaflet and stronger accessory setae; lateral plate of phallosome with more numerous and finer denticles; proctiger crown with coarser spicules; 3 cercal setae present.

PUPA and LARVA. Unknown.

TYPE DATA. Lectotype: male (slide of terminalia only), marked as cotype, reared from a mixed batch of larvae collected from pools and pits among undergrowth, Moon Plains, Nuwara Eliya, 6000 ft, CEYLON, November 1937, J. L. N. Fernando (BM). **PRESENT SELECTION.**

DISTRIBUTION. Known only from the type locality in Ceylon. Material examined: 1 ♂ terminalia slide, as indicated in the type data.

TAXONOMIC DISCUSSION. *C. campilunati* is very close to *pluvialis* in several details of the male terminalia, but differs from the latter in the presence of 6-7 setae on the apex of the basimere and in the other features as given in the above diagnosis. Carter and Wijesundara (1948: 143-144) noted that it is a comparatively larger form similar to *iphis* from India.

The type and other specimens in the type series of *campilunati* were completely destroyed during transit except for the single slide of the male terminalia (Dr. P. F. Mattingly, per. comm.). The above recognition of this species as distinct from *pluvialis* is based on this specimen only and more material is required in confirming its specific status.

BIOLOGY. Except as indicated in the type data, nothing more is known about the biology of *campilunati*.

17. *Culex (Eumelanomyia) selai* Klein and Sirivanakarn (Fig. 10A, ♂ terminalia)

Culex (Mochthogenes) selai Klein and Sirivanakarn 1969, Proc. ent. Soc. Wash. 71: 589 (♂*).

Culex (Eumelanomyia) selai, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE: Unknown.

MALE. Essentially as described by Klein and Sirivanakarn (1969: 589-591); very similar to *pluvialis* and *campilunati*, differing from them in the following characters. *Head*. Decumbent scales on dorsal eye margin and in center of vertex broader and predominantly dark; narrow decumbent scales restricted to occiput; erect scales entirely dark; antennal flagellar whorls more strongly plumose, normal whorls with 35 or more hairs. *Terminalia* (Fig. 10A). As figured; tergal lobe of segment IX with 5-10 setae; basimere with a row of 5-7 stronger submarginal setae which are flattened and striated, resembling those in *C. malayi*; apex of basimere bears 2-3 weak setae; lateral plate of phallosome abruptly tapered to a short blunt apex, with a pronounced

angle on lateral margin, denticles stronger and apparently fewer, inner basal denticle usually large or well developed.

PUPA and LARVA. Unknown.

TYPE DATA. Holotype: male (212) with terminalia slide, Kompong Sela, Koh Kong, CAMBODIA, 5 November 1967, reared from larva from a pool under forest in foothill area, J. M. Klein (USNM).

DISTRIBUTION. Presumably widely spread but at present, *selai* is known only from the type locality in Cambodia and from Borneo, East Malaysia.

Material examined: 12 ♂.

CAMBODIA. Koh Kong: Kompong Sela, 11 ♂.

MALAYSIA. East Malaysia: Sabah, Tawau, 1 ♂.

TAXONOMIC DISCUSSION. In addition to the diagnostic characters given in the key, *selai* differs from *pluvialis* and *camfilunati* conspicuously in having broader and darker decumbent scales on the vertex and in having the erect scales of the head entirely dark. This condition resembles the species in the *malayi* subgroup so closely that it can be easily confused with them except by the examination of the male terminalia. The type and other topotypic males of *selai* from Cambodia are also distinct from *pluvialis* and *camfilunati* in the presence of a strong inner basal denticle on the lateral plate of phallosome but in a specimen from Borneo, this denticle is poorly developed or absent.

BIOLOGY. The adult males of *selai* were obtained from general field catch and from rearing larvae collected in a pool under forest shade in mountainous areas of Cambodia. The field data of a single male collected from Borneo are not available. Nothing is known about adult biology.

khazani subgroup

The *khazani* subgroup includes only *C. khazani* and is characterized below under the description of this species. In the earlier paper (Sirivanakarn 1971), I provisionally assigned this species to the *tenuialpis* subgroup. However, after having studied the male terminalia in detail, I found it so distinct that I am now recognizing it as a separate subgroup. The *khazani* subgroup is known only from India.

18. *Culex (Eumelanomyia) khazani* Edwards (Fig. 10B, ♂ terminalia)

Culex khazani Edwards 1922b, Indian J. med. Res. 10: 286 (♂*, ♀); Barraud 1924a, Indian J. med. Res. 11: 1281 (♂*, ♀).

Culex (Micraedes) khazani, Edwards 1922a, Bull. ent. Res. 13: 92 (♂).

Culex (Mochthogenes) khazani, Edwards 1932, in Wytzman, Genera Insect. fasc. 194: 195 (taxonomy); Barraud 1934, Fauna Brit. India, Diptera 5: 357 (♂*, ♀, L).

Culex (Eumelanomyia) khazani, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.5 mm, fore femur 1.25 mm, abdomen 1.5 mm. Small sized, dark brown species. *Head*. Decumbent scales on dorsum of vertex predominantly narrow and fine; broader along lateral eye margin; erect scales slender, predominantly pale or yellowish brown; palpus about 0.2 of proboscis; proboscis with 4 strong and dark labial basal setae which are slightly longer than palpus. *Thorax*. Integument of scutum and scutellum brown; scutal scales narrow, rather fine and entirely dark; acrostichal bristles present, widely spaced; dorsocentral bristles strong and dark; pleuron paler than scutum except for *mep* which is as dark as scutum, scales absent; 1 lower *mep* bristle present. *Legs*. Anterior surface of hind femur nearly entirely white from base to apex; tibiae and tarsi dark scaled. *Wing*. Scales narrow, long and moderately dense. *Abdomen*. Terga dark brown scaled; sterna paler scaled.

MALE. In general similar to female, with the following diagnostic features.

Head. Proboscis without false joint; flagellar whorls of antenna weakly plumose, normal whorls with about 15 hairs, minor whorls with 4-5 hairs.

Terminalia (Fig. 10B). Tergum of segment IX with a prominent median lobe bearing 10 strong setae and a linear row of 7-8 weaker setae on each side laterally; basimere distinct in shape, inner tergal surface slightly swollen, with numerous strong and weak setae which are densely packed; a few scales present on external tergal surface; subapical lobe clearly divided into proximal and distal divisions, proximal division with 3 rods, 2 of which are stout and 1 very narrow and thin, distal division with a lateral group of 1 strong seta and 1 very broad and rather thick leaflet and a distinct mesal lobe which bears 4 narrow blade-like setae and 1 spatulate leaflet; distimere distinct in shape, basal half uniformly thick, apical half expanded before tapering into a broad truncate apex, claw small and placed apically, 2 ventral subapical setae and 6-7 minute setae present just beyond the middle; phallosome subspherical in shape, dark brown, lateral plate broad oval-shaped, with 10-12 heavy denticles on inner tergal surface and a variable number of weak denticles laterally; proctiger crown dark, medium sized, consisting of several strong spine-like spicules, lateral paraprot and cercal sclerite dark and strongly sclerotized; 3-4 cercal setae present.

PUPA. Unknown.

LARVA. Based on 2 whole mounted specimens tentatively associated with the adults by Barraud (1934: 357). Head 0.65 mm, siphon 1.5 mm, index 8, saddle 0.30 mm, siphon/saddle ratio 5. In general conforms to the subgenus with the following diagnostic features. *Head.* Antennal shaft entirely dark, spicules strong; hair 1-C a dark stout spine; 4-C long, about as long as the distance between bases of the pair; 5, 6-C strong, subequal in length, their tips reaching beyond anterior margin of frontoclypeus, 5-C double; 6-C usually double (2-3); 7-C 6-7b. *Thorax.* Unspiculated; 3-P triple; 4-P as long as 1 or 2-P, single; 7-P double; 8-P single. *Abdomen.* Hairs 6-I-II strong and dark, double; 7-I as strong as 6-I-II, single; comb scales about 40 in number, all equal in size and with even fringes of fine spicules; hair 2-VIII single. *Siphon.* Moderately long and slender; uniformly brownish; 12 pecten teeth present, graded in size, distal teeth slightly longer than basal ones, most distal teeth with 3 strong basal denticles and 10-12 fine distal denticles; siphonal tufts 6 pairs in number, subventral in position, each 5b, all subequal in length, about as long as siphon width at point of insertion. *Anal segment.* Concolorous with siphon; hair 2-X double; ventral brush of 7 pairs of hairs, all inserted within grid; anal gills as long as saddle.

TYPE DATA. Holotype: male, Pudupadi, Malabar Coast, S. W. INDIA, reared from larva collected from a tree hole, November 1915, Rai-Sahib, Sub-assistant Surgeon, Khazan Chand (BM).

DISTRIBUTION. Known only from India. Material examined: 3♂, 1♀, 2 L. INDIA. Pudupadi, Malabar Coast, S. W., 1♂ (holotype). Kadra, North Kanara, 2♂♂, 1♀, 2 L.

TAXONOMIC DISCUSSION. *C. khazani* as interpreted here is known only from India. The record of this species in North Vietnam by Galliard and Ngu (1949) is incorrect judging from their published figures of the larva and the male terminalia. It appears most probable that the specimens recorded by these authors are in fact *C. malayi*. The type and other topotypic material of *khazani* agrees well with the description and the figure by Barraud (1934). The larva which was tentatively associated with the adult by Barraud is probably correct on the basis of the field data.

C. khazani which is considered here as belonging to its own subgroup is strongly differentiated from other members of the *mochthogenes* group by the tergal lobes of segment IX, basimere and distimere of the male terminalia. It appears to be related to the *temuipalpis* subgroup on the basis of similarity in the shape and denticulation of the male phallosome. The presumptive larva of this species is also very distinct from the known larvae in the other subgroups of *mochthogenes* in having hairs 4, 5 and 6-C strong and long; prothoracic hair 4-P of the same magnitude as hairs 1 and 2-P and in having the

siphonal tufts inserted subventrally.

BIOLOGY. The type and other topotypic adult specimens of this species were obtained from rearing the larvae collected in treeholes, but the correlated skins were not preserved. The biology of the adults is unknown.

tenuipalpis subgroup

FEMALE. Small to medium sized species, wing length between 2.7-3.7 mm. *Head.* Anterior dorsal margin and center of vertex clothed with narrow, linear decumbent scales; palpus from 0.1 to 0.2 of the length of proboscis; labial basal setae as long as palpus. *Thorax.* Acrostichal bristles well developed; pleural area uniformly pale brown; a few pale translucent scales present on upper corner of *stp*; lower *met* bristle present. *Abdomen.* Terga usually entirely dark, sometimes with narrow basal pale bands on terga III-VII; sterna paler scaled than terga.

MALE. Similar to female in general, differing in the following. *Head.* Palpus varied from 0.2 to 0.75 of proboscis length; labial false joint usually present and clearly marked at 0.75 of the length from extreme base; large flagellar whorl densely plumose, with 30-40 hairs. *Terminalia.* Tergal lobe small with 5-7 weak and short setae; basimere slender, elongate, roughly conical, inner tergal surface usually with 1 strong submarginal seta, sometimes with a linear row of 4-5 strong submarginal setae; subapical lobe not clearly divided into proximal and distal divisions; proximal division with 3 slender, subequal rods, distal division with a strong seta and a very small, rather indistinct leaflet laterally and with 4-5 close-set blades mesally; distimere slender, sickle-shaped, moderately long and tapered to a small point distally, subapical claw slender and short; lateral plate of phallosome broad oval or sometimes distally tapered, denticles strong and numerous, proctiger crown with a few strong and several weak spinelike spicules.

PUPA. Abdomen 1.9-2.2 mm, paddle 0.45-0.65 mm, trumpet 0.42-0.6 mm, index 9-11. In general conforms to the description of the *mochthogenes* group, the following hairs are characteristic. *Cephalothorax* and *Metanotum.* Hair 8-C double, sometimes single; 9-C single or double; 10-C double. *Abdomen.* Hair 5-IV usually 3-4b, sometimes double; 5-V, VI usually double, sometimes 3-4b; hair 4-VIII single, sometimes double.

LARVA. Head 0.65 mm, siphon 0.95-1.2 mm, index 5, siphon/saddle ratio about 3. Essentially as described for the *mochthogenes* group, rather similar to the *foliatus* subgroup in having prothoracic hair 4-P considerably weaker than hair 3-P and in several features of the chaetotaxy, differing in the following. *Head.* Usually with pattern of dark and light areas; hair 1-C rather longer. *Thorax.* Hair 4-P always double. *Abdomen.* Hairs 6-III-VII double or triple. *Siphon.* Relatively thicker and darker, subventral tufts stronger, from 3-5 times as long as siphonal width at points of insertion.

DISCUSSION. The *tenuipalpis* subgroup as reinterpreted here is a complex of 5 closely related species, including *tenuipalpis* Barraud 1924, *richei* Klein 1970, *hayashii* Yamada 1917, *hackeri* Edwards 1923 and *kiriensis* Klein and Sirivanakarn 1969. This grouping is based on the similarity in several details of the male terminalia, type of decumbent scales of the vertex and in strong plumosity of the male antennal flagellar whorls. Of these 5 species, *hackeri* and *kiriensis* have the male palpus as short as in the female whereas *tenuipalpis*, *richei* and *hayashii* have the male palpus varying from 0.5 to 0.75 of the proboscis length. The identity of these species is determined by the relative length of the male palpus, the shape of the lateral plate of the male phallosome, the number of denticles present and the number of submarginal setae of the basimere. The female cibarial teeth are also diagnostic as this structure varies in number, size, and in arrangement of the teeth among different species. The pupae and larvae which are known only in certain forms also appear to show specific differences in the branching of certain hairs.

The *tenuipalpis* subgroup is perhaps the most interesting lineage from the standpoint of evolution and speciation of *Eumelanomyia* in the Oriental region.

On the basis of the comparative male morphology, this subgroup appears to be most generalized, showing an overlap with the *protomelanoconion* group in the length of male palpus and in the male terminalia. The type of the male phallosome in the majority of species in this subgroup is similar in being sub-spherical and apparently resembles that of *simplicicornis* in the *rubinotus-rima* group. Within the *mochthogenes* group, the *tenuipalpis* phallosome also shows an overlap with the *khazani*, *okinawae*, *pluvialis* and *malayi* subgroups. This evidence seems to suggest that the *tenuipalpis* subgroup is probably the most primitive stock which was derived from the *rubinotus-rima* group and then gave rise to the *protomelanoconion* group and subgroups of the *mochthogenes* group. This relationship between the members of the *tenuipalpis* subgroups and other subgroups of *mochthogenes* is also partially supported by the comparative morphology of the immature stages. The affinities between the *tenuipalpis* subgroup and the *rubinotus-rima* group can not be further clarified here until the subgenus as a whole is completely revised from a broader range of distribution than the present study.

The members of the *tenuipalpis* subgroup are more or less restricted to a high altitude and those with known immature stages breed in ground pools. In the Oriental region this subgroup has been recorded only from India, Thailand, Malaya, Cambodia and the Ryukyu Islands with extension into Japan and Korea and probably also into China and U. S. S. R.

19. *Culex (Eumelanomyia) tenuipalpis* Barraud
(Figs. 10C, ♂ terminalia; 10D, ♀ cibarial armature;
11A, pupa; 11B, larva)

- Culex tenuipalpis* Barraud 1924a, Indian J. med. Res. 11: 1278 (♂*, ♀); Barraud 1924b, Indian J. med. Res. 12: 433 (L*); Barraud and Covell 1928, Indian J. med. Res. 15: 671-679 (♀ buccopharyngeal armature*).
Culex (Neoculex) tenuipalpis, Edwards 1932, in Wytzman, Genera Insect. fasc. 194: 195 (taxonomy); Barraud 1934, Fauna Brit. India, Diptera, 5: 351 (♂*, ♀, L*); Bram 1967, Contrib. Amer. Ent. Inst. 2: 29 (♂*, ♀, L*);
Culex (Eumelanomyia) tenuipalpis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.7 mm, fore femur 1.1 mm, proboscis 1.6 mm. Brown to dark brown, medium sized species. *Head.* Decumbent scales on anterior dorsal margin and in center of vertex narrow and predominantly pale yellowish; erect scales numerous, very slender, pale anteriorly, dark posterolaterally; palpus slender, about 0.2 of proboscis length; 2 labial basal setae as long as palpus. *Cibarial armature.* (Fig. 10D). Distinctive; cibarial bar with at least 60 fine and pointed teeth in row which is strongly convex in middle and concave towards lateral flanges. *Thorax.* Scutum brownish, scutal scales predominantly dark except for some pale ones on anterior promontory and anterior margin of fossa; acrostichal bristles rather strong; pleuron same color as scutum or sometimes dark above, pale below; upper corner and lower posterior border of *stp* with a few pale translucent scales. *Legs.* Anterior surface of hind femur silvery white scaled. *Wing.* Plume scales narrow, dark and rather dense on all veins. *Abdomen.* Terga III-VII with narrow pale basal bands, or sometimes entirely dark; sterna pale scaled.

MALE. Similar to female except for the following. *Head.* Decumbent scales on vertex and scales in lateral patch paler; palpus longer, about 0.5 of proboscis length, apparently 5-segmented, segments 4 and 5 very short and bare, its combined length about 0.2 of the length of segment 3; labial basal setae as in female; labial false joint present and clearly marked by flexion just beyond the middle; antennal flagellum very strongly plumose. *Terminalia* (Fig. 10C). Tergal lobe of segment IX small, 5-6 tiny setae present; basimere slender, conical, inner tergal surface with 1 strong submarginal seta basad, lateral tergal area with a small number of weak setae; strong bristles confined

to external tergal surface; proximal and distal divisions of subapical lobe not clearly divided, all setae placed close together; proximal division with 3 slender subequal rods; distal division with 1 strong basal seta and 1 narrow, thin acuminate leaflet laterally and a mesal group of 2-3 hair-like setae and 4 flattened apically blunt blade-like setae, of which the most distal is provided with a fringe of fine spicules subapically; distimere slender, sickle-shaped, basal half broad, with 2-4 fine setae dorsally, apical half tapered to a small point; subapical claw slender and short; 1 or 2 tiny ventral subapical setae present just beyond middle of curvature; phallosome globular or subspherical in shape, lateral plate broad oval, with about 20 heavy denticles scattered on tergal surface; proctiger crown medium sized, consisting of 4-5 coarse and several fine and pointed spicules, paraproct narrow, with a small apical lobe; 3 tiny cercal setae present.

PUPA (Fig. 11A). Abdomen 2.2 mm, paddle 0.56 mm, trumpet 0.6 mm, index 10-11. Pigmentation pale yellowish; trumpet dark, relatively long and uniformly cylindrical; pinna with slit extended to meatus; chaetotaxy as figured, the combination of the following hairs is diagnostic. *Cephalothorax* and *Metanotum*. Hairs 7, 8-C double; 8-C very strong and long; 9-C single; 10-12-C double. *Abdomen*. All hairs relatively strong and long; hairs 5-II, III double; 5-IV-VI double; 6-III-VI double; 2-VII always mesad of 1-VII. *Paddle*. Same color as abdomen; midrib weak and lightly pigmented; hairs 1, 2-P present, 1-P very weak and short, 2-P stronger and longer.

LARVA (Fig. 11B). Based on a single skin from the type locality. Head 0.65 mm, siphon 1.2 mm, index 5, saddle 0.38 mm, siphon/saddle ratio 3. As figured, with the following distinctive features. *Head*. Antennal shaft dark at base, pale in middle and slightly dark beyond hair 1-A; hair 4, 5-C tiny, subequal, about 0.3 of the length of hair 6-C, both single; 6-C double, almost reaching anterior margin of frontoclypeus. *Thorax*. Hair 4-P minute, about 0.25 of hair 3-P, double; 7, 8-P single. *Abdomen*. Hairs 6-III-VI double; comb scales about 40 in number, all equal in size and with rounded apical fringe of fine spicules. *Siphon*. Broad at base, strongly tapered and curved upwards distally; 5 pairs of ventral tufts present, the first 2 tufts 3b, their lengths 4-5 times as long as siphon width at point of insertion, the next 2 tufts gradually shorter, 4b; the most distal tuft very short, 4b, about 1.5 times as long as siphon width at point of insertion; pecten teeth 8-9 in number; hair 2-S a long and strong spine; hair 9 of ventral valve of spiracle strong and hooked apically. *Anal segment*. Hair 1-X 4b; 2-X double; ventral brush with 6 pairs of hairs, all inserted within grid.

TYPE DATA. Lectotype: male (BM 1923-585) with terminalia slide, 5,500 ft, Darjeeling Hills, *Sureil*, E. Himalaya, INDIA, October 1922, P. J. Barraud (BM). **SELECTION OF BRAM** (1967: 31).

DISTRIBUTION. Known only from the north of India and Thailand.

Material examined: (12♂, 23♀, 1 L; 3 with associated pupal skins.

INDIA. *Sureil*: near Mungpoo, Darjeeling Hills, E. Himalaya; 10♂, 21♀, 1 L.

THAILAND. *Chiang Mai*: Tad Mue Fall, Doi Sutep, 1♂. *Mae Hong Son*: Ban Mae Honua, 1♂, 2♀, 3 p.

TAXONOMIC DISCUSSION. *C. tenuipalpis* appears to be restricted to the high mountain areas and at present it has definitely been recorded only from India and Thailand. The record by Brug and Bonne-Wepster (1947: 186) from Java requires confirmation. The above description of the adults and larva of *tenuipalpis* is based largely on the topotypic material from India and that of the pupa is based on the specimens correlated with the known males from northern Thailand. Among the members of the *tenuipalpis* subgroup, this species is very similar to *richei* and *hayashii* in having a long male palpus about 0.5 of the length of proboscis. It is, however, separated from *richei* by the presence of only 1 strong submarginal seta on the basimere (4 in *richei*) and from *hayashii* by the presence of 2-4 tiny setae in basal half of the distimere and by the presence of more numerous denticles on the lateral plate of the phallosome. The female is distinguished from *hayashii* by the presence of

more numerous cibarial teeth. The pupa and larva are also distinct from *hayashii* as indicated in the keys and as in the above diagnosis. The basal pale bands on the abdominal terga of *tenuipalpis* adults are present in all topotypic specimens from India but are absent in those from Thailand. However, as the specimens from the two localities show no differences in the male terminalia and in the female cibarial armature, I have no doubt that they are conspecific.

BIOLOGY. The breeding habitats of *tenuipalpis* in India (Barraud 1924b, 1934) are roadside pools and in Thailand elephant foot prints. In India, collection of the specimens was made at an altitude of 5,000-5,500 ft. (approximately 1600 m) and those from Thailand were at an altitude of about 900 m. A single male collected in Thailand was from a light trap. Nothing is known about adult biology.

20. *Culex (Eumelanomyia) richei* Klein
(Fig. 12A, ♂ terminalia)

Culex (Neoculex) richei Klein 1970, Proc. ent. Soc. Wash., 72: 504-506 (♂*).

FEMALE. Unknown.

MALE. As characterized by Klein (1970: 504-505), very similar to *C. tenuipalpis*, differing particularly in the following features. *Head.* Palpus longer, about 0.75 of proboscis length; labial basal setae of proboscis weaker and shorter. *Thorax.* Acrostichal bristles on scutal disc stronger, scutal scales finer, shiny brown and rather sparse. *Abdomen.* Terga and sterna entirely dark scaled. *Terminalia* (Fig. 12A). Essentially as figured here and by Klein (1970: 505), similar to *tenuipalpis* in general facies and in the shape of the phallosome, differing from it in the following. Inner surface of basimere with a linear row of 4 strong submarginal setae which are sinuous and recurved towards apices; proximal division of subapical lobe with 3 rather thick rods; distal division with a lateral group of a strong seta, a large acuminate leaflet and a mesal group of 2 strong setae and 4 flat apically blunt blade-like setae of which the most distal one is fringed with fine spicules subapically; phallosome with strong denticles confined to inner tergal surface of lateral plate, lateral tergal area bare; proctiger with larger crown of more numerous spines.

PUPA AND LARVA. Unknown.

TYPE DATA. Holotype: male (456) with terminalia slide, Popork Vill., in Bokor Hill, *Kampot*, CAMBODIA, 24 February 1969, J. M. Klein (USNM).

DISTRIBUTION. Known only from the type locality. Material examined: 1 ♂ (holotype), as indicated in the type data.

TAXONOMIC DISCUSSION. This species although described from a single male is undoubtedly distinct on the basis of the characters as given in the key and as described above. It is separable from *tenuipalpis* and *hayashii* by having a longer palpus which is about 0.75 of the proboscis length and by the presence of 4 strong submarginal setae on the basimere of the male terminalia.

BIOLOGY. The single male of *richei* was collected from a forest in hill country in association with specimens of *kiriensis*, *bokorensis*, *otachati* and *selai*. Nothing is known about its breeding habitat and adult biology.

21. *Culex (Eumelanomyia) hayashii* Yamada
(Figs. 12B, ♂ terminalia; 12C, ♀ cibarial armature;
13A, pupa; 13B, larva)

Culex hayashii Yamada 1917, Zool. Mag. Tokyo, 29: 67 (♂*, ♀, P, L, E);
Edwards 1921, Bull. ent. Res. 12: 336 (♂*).

Culex (Neoculex) hayashii, Edwards 1932, in Wytzman, Genera Insect. fasc. 194: 195 (taxonomy); Bohart and Ingram 1946, U. S. Navmed 1055: 71

(♂*, ♀, L*, E); LaCasse and Yamaguti 1950, Mosq. Fauna, Japan and Korea, 257 (♂*, ♀*, L*); Monchadskii 1951, Tabl. anal. Faune U. S. S. R. 37: 250 (L); Hara 1957, Japan J. exp. Med. 27: 57 (♀ terminalia*) Lien 1962, Pacif. Ins., 4: 631 (distribution).

Culex (Eumelanomyia) hayashii, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 3.0-3.7 mm, fore femur 1.5-1.9 mm, proboscis 1.9 mm. In general extremely similar to *tenuipalpis*, differing in the following. *Head*. Narrow decumbent scales on vertex finer and entirely pale yellowish; all erect scales yellow or yellowish white. *Cibarial armature* (Fig. 12C). Cibarial bar with about 50 teeth, lateral teeth coarser than middle teeth, all arranged in concave row. *Thorax*. Scutal integument paler, light brown; scutal scales predominantly light brown; scutellar scales yellowish pale. *Abdomen*. Terga entirely brown or dark brown scaled; sterna yellowish scaled.

MALE. In general similar to female, differing from *tenuipalpis* and *richei* in the following. *Head*. Palpus varying from 0.5 to 0.75 of proboscis length. *Terminalia* (Fig. 12B). As figured, extremely similar to *tenuipalpis*, differing chiefly in the following. Basal half of distimere without any setae on dorsal surface; lateral plate of phallosome more or less pointed at apex, denticles fewer, about 7-10 present, all are restricted to inner tergal surface.

PUPA (Fig. 13A). Abdomen 1.9 mm, paddle 0.45 mm, trumpet 0.42 mm, index 9. Generally similar to *tenuipalpis*, differing from it in having weaker hairs and in the following. *Cephalothorax* and *Metanotum*. Hair 8-C weak, subequal to 9-C. *Abdomen*. Hair 5-IV 3-4b; 5-V, VI double; 6-IV-VI usually 4b(3-4); 2-VII lateral to 1-VII.

LARVA (Fig. 13B). Head 0.65 mm, siphon 0.95 mm, index 5, saddle 0.30 mm, siphon/saddle ratio 3. In general similar to *tenuipalpis*, differing in the following. *Head*. Hair 4-C shorter than 5-C; 5-C about 0.5 of 6-C. *Abdomen*. Hairs 6-III-VI triple. *Siphon*. Slender, slightly tapered distally and straight, not curved upwards; 6 pairs of siphonal tufts present, all apparently weaker and shorter, first 5 tufts about 2-3 times as long as siphon width at point of attachment; hair 2-S weaker and shorter. *Anal segment*. Hair 2-X with 1 long and 2 short branches; ventral brush usually with 1 or 2 proximal hairs detached from grid.

TYPE DATA. The original description of *hayashii* by Yamada was based on the males, females, pupae, larvae and eggs from Tokyo, Japan, but type designation was not specified. All of these specimens were deposited in the Department of Parasitology, Institute of Medical Science, University of Tokyo. Dr. Manabu Sasa informs us that they are no longer available for lectotype selection.

DISTRIBUTION. Material examined: 19♂, 29♀, 12 L; 8 with associated lp skins.

JAPAN. *Honshu*: Sagiyaama Saitama; Tokyo; 5♂, 3♀.

KOREA. *Seoul*, 3♂, 4 L.

RYUKYU ISLANDS. *Okinawa*: Kochiya; Chizuka; Nakasoni; Arokawa; Ishigaki Inoda; Yaeyama, 3/4 mi southwest of Ibaruma; 7♂, 23♀, 5 L. *Iriomote*: 1 1/2 mi north of Toyohara village; G. Takaesu, 2 mi west of Yabu village; 4♂, 4♀, 3 L, 8 lp.

Additional records from the literature: TAIWAN (Lien 1962); U. S. S. R., Maritime Province (Monchadskii 1951).

TAXONOMIC DISCUSSION. The adults of *C. hayashii* show a great deal of variation in size, color, texture of scutal scales and in the length of male palpus. The specimens from the Ryukyu Islands differ from the specimens from Japan and Korea in smaller size, darker coloration, finer scutal scales and shorter male palpus. However, these differences are not correlated with any differentiation in the male terminalia, indicating that there is in all probability only one species involved.

C. hayashii is apparently a common form and is quite well known in Japan (LaCasse and Yamaguti 1950) and Okinawa in the Ryukyu Islands (Bohart and

Ingram 1946). The records of this species from Taiwan by Lien (1962) and from U. S. S. R. by Monchadskii (1951) are doubtful as these were based only on the larva. In addition to the records given above, it is possible that *hayashii* may also occur on mainland China.

Except as noted in the keys, *C. hayashii* is extremely similar to *tenuipalpis* in male characters but can be clearly distinguished from the latter by the female cibarial armature, pupa and larva as described above. The adults of this species also differ from the typical form of *tenuipalpis* in the absence of basal bands on the abdominal terga. In the Ryukyu Islands and possibly also in Taiwan, the immature stages and the females of this species can be easily confused with *okinawae* from which it differs most strikingly in several features of the male terminalia. The close similarity between the male terminalia of *hayashii* and *tenuipalpis* strongly suggests that it is probably derived from the latter through geographic isolation.

BIOLOGY. The most frequent breeding sites of *hayashii* in Japan (LaCasse and Yamaguti 1950) include fresh water ponds, drainage ditches and irrigation ditches at an altitude of about 1000 m. The larvae were collected in association with the specimens of *Anopheles sinensis* and *Culex* (*C.*) *tritaeniorhynchus*. In the Ryukyu Islands (Bohart and Ingram 1946), the immatures were collected mainly from rock pools or side pools of a small stream in association with *Culex* (*C.*) *bitaeniorhynchus* and *Culex* (*L.*) *infantulus*. The current field record from a treehole by A. B. Silagan in Iriomote, Ryukyus as noted above is probably erroneous. Nothing is known about adult biology.

22. *Culex* (*Eumelanomyia*) *hackeri* Edwards
(Figs. 14A, ♂ terminalia; 14B, ♀ cibarial armature)

Culex hackeri Edwards 1923, Bull. ent. Res. 14: 4 (♂).

Culex (*Mochthogenes*) *hackeri* Edwards 1932, in Wytzman, Genera Insect. fasc. 194: 195 (taxonomy).

Culex (*Eumelanomyia*) *hackeri*, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 3.0 mm, fore femur 1.5 mm, proboscis 1.9 mm. Abdomen 1.9 mm. Medium sized, very dark to nearly black species. Very similar to *tenuipalpis* and *hayashii*, differing in darker coloration and as in the following. **Head.** Palpus shorter, about 0.1 of proboscis length; labial basal setae of proboscis about as long as palpus. **Cibarial armature** (Fig. 14B). Cibarial teeth more numerous, about 90 in number, all very fine, subequal in size, arranged in a broad convex row. **Thorax.** Integument of scutum and scutellum nearly black; scutal scales as dark as integument. **Legs.** Anterior surface of hind femur with silvery white stripe extending from base to apex. **Wing.** Plume scales very dense on all veins. **Abdomen.** Terga dark to black scaled; sterna paler scaled.

MALE. Differing from *tenuipalpis* and *hayashii* generally as described for female and as in the following. **Head.** Palpus shorter, varying from 0.15-0.20 of proboscis length; labial false joint not clearly marked. **Terminalia** (Fig. 14A). Extremely similar to *tenuipalpis*, differing in having blade-like setae in distal division of subapical lobe stronger and broader, lateral plate of phallosome with 5-6 strong and 7-8 small denticles; proctiger crown darker and larger, spicules apparently more numerous.

PUPA and LARVA. Unknown.

TYPE DATA. Lectotype: male, Cameron Highlands, 3500-5000 feet, Pahang, (Malaya) WEST MALAYSIA, 1923, Dr. H. P. Hacker (BM); **PRESENT SELECTION.**

DISTRIBUTION. Known only from the type locality. Material examined: 4♂, 2♀.

TAXONOMIC DISCUSSION. The malayan *hackeri* is known only from 4 males and 2 females in the original type series. In Edwards' description of

this species, the male terminalia were not illustrated. I have, however, checked the type and other specimens in the type series and found them agreeing well with his verbal description of this species.

C. hackeri shows a great deal of similarity to *tenuipalpis* in details of the male terminalia, but differs strikingly from the latter in having the male palpus reduced to about 0.2 of the length of the proboscis. The female cibarial armature also resembles *tenuipalpis* in the arrangement of the teeth except as indicated in the key and as described above.

BIOLOGY. The breeding habitat of this species is ground pool. The adults in the type series were obtained from mass rearing from larvae collected in pools at the edges of a stream (Edwards 1923: 4). It is apparently a rare form as no more specimens have ever been recovered from the type locality or from anywhere in Malaya. The collection of the original specimens in the type series was from a high altitude.

23. *Culex (Eumelanomyia) kiriensis* Klein and Sirivanakarn
(Figs. 14C, ♂ terminalia; 14D, ♀ cibarial armature)

Culex (Mochthogenes) kiriensis Klein and Sirivanakarn 1969, Proc. ent. Soc. Wash. 71: 583 (♂*).

Culex (Eumelanomyia) kiriensis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.8 mm, fore femur 1.33 mm, proboscis 1.52 mm, abdomen 1.9 mm. Very similar to *hackeri*, differing chiefly in the following. *Cibarial armature* (Fig. 14D). Cibarial bar narrower; number of teeth greatly reduced, about 16-18 present, middle 12 teeth fine, long and pointed, lateral 4-6 teeth shorter, much coarser and abruptly pointed or truncate apically, all in a slightly concave row.

MALE. As described by Klein and Sirivanakarn (1969: 583); in general as in female, similar to *hackeri* in having palpus reduced to about 0.2 of proboscis, differing in the following. *Head.* Proboscis relatively thicker, labial false joint clearly marked at about 0.75 of the length from base. *Terminalia* (Fig. 14C). Blade-like setae in the distal division of subapical lobe 4 in number (5 in *hackeri*); distimere more slender, subapical claw narrower but relatively longer; lateral plate of phallosome tapered dorsally into a blunt apex, 5-6 strong denticles present, all apparently restricted to inner tergal surface.

PUPA. Abdomen 2.2 mm, paddle 0.65 mm, trumpet 0.6 mm, index 10. As figured for *tenuipalpis* and *hayashii*, differing particularly in the following chaetotaxy. *Cephalothorax* and *Metanotum.* Hair 8-C single or with 1 long and 1 short branch; 9-C very weak and short, single or double; 10 and 11-C weaker. *Abdomen.* Hair 5-II-III, 7-8b; 5-IV, V usually 4(4-5) and 3-4b respectively, their length about 0.5 of the segments following; 5-VI triple; 2-VII dorsolateral to 1-VII; 4-VIII double.

LARVA. Unknown.

TYPE DATA. Holotype: male (409) with slide of terminalia, Bokor hill, Kampot, CAMBODIA, 25 April 1968, J. M. Klein (USNM).

DISTRIBUTION. Known only from Thailand and Cambodia. Material examined: 16♂, 1♀; 3 with associated pupal skins.

THAILAND. *Lamjang:* Ngao, Payao road; Ban Pha Daeng; 6♂, 1♀, 2 p. *Nakhon Ratchasima:* Khao Yai National Forest, 2♂. *Krabi:* Khao Aopong, 1♂, 1 p.

CAMBODIA. *Kampot:* Bokor hill (Type Locality), 1♂ (holotype). *Kampong Speu:* Kirirom hill; O'Tachet; Pichnil Stung Chral; 6♂.

TAXONOMIC DISCUSSION. *C. kiriensis* Klein and Sirivanakarn (1969) was originally recognized only in the male. The above description of the female and pupa of this species is based on a specimen definitely correlated with the male through reared material recently received from Thailand. This species is apparently more common than the malayan *hackeri* and also appears to be widely spread throughout Thailand and other adjacent countries. However, at

present it is known only from Thailand and Cambodia.

C. kiriensis undoubtedly belongs to the *tenuipalpis* subgroup on the basis of the general external features and male terminalia. The male palpus of this species is as short as in *hackeri* which is strikingly different from *tenuipalpis*, *richei* and *hayashii*. It can be clearly separated from *hackeri* and also the 3 other mentioned species by the shape of the lateral plate of the phallosome and by the female cibarial armature as figured and as described above. The chaetotaxy of the pupa is also distinct from *tenuipalpis* and *hayashii* in the combination of certain hair branchings as described above. The male phallosome of *kiriensis* is apparently rather similar to the members of the *pluvialis* and *malayi* subgroups. The female cibarial armature is rather unique, unlike all other known Oriental species and shows some resemblance to *rubinotus* and *andreas* from the Ethiopian region (Edwards 1941: 250).

BIOLOGY. The adults of *kiriensis* were collected while resting on low vegetation near a stream in mountain forests. The pupae were collected twice, once in a pool in the middle of a dried up stream and once in a pool at stream margin. The biology of the adults is practically unknown.

okinawae subgroup

The *okinawae* subgroup includes only *okinawae* and is characterized below in the description of this species. This subgroup is distinguished from the *tenuipalpis* subgroup in the male terminalia by characters of the tergal lobes of segment IX, basimere and the distimere. It shows a strong affinity with members of the *tenuipalpis* subgroup on the basis of similarity in the shape of the lateral plate of the male phallosome and in the immature stages. At present, this subgroup is known only from the Ryukyu Islands, Taiwan and the Philippines. The recorded breeding habitats are rock pools and ground pools.

24. *Culex (Eumelanomyia) okinawae* Bohart
(Figs. 15A, ♂ terminalia; 15B, ♀ cibarial armature;
16A, pupa; 16B, larva)

Culex (Neoculex) okinawae Bohart 1953, Proc. ent. Soc. Wash. 55: 187 (♂*, ♀, P, L).

Culex (Neoculex) lini Lien 1968, Trop. Med. Nagasaki, 10: 225 (♂*, ♀, P*, L*). **NEW SYNONYM.**

Culex (Eumelanomyia) okinawae, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 2.8-3.6 mm, fore femur 1.3-1.6 mm, proboscis 1.6-1.8 mm. Small or medium sized, dark to black species. **Head.** Decumbent scales on dorsum of vertex entirely narrow, predominantly pale yellowish; erect scales numerous, slender and entirely dark; lateral patch of broad appressed scales dingy white; palpus 0.2 of proboscis length; 4 labial basal setae present, all hair-like, 2 lateral setae longest, about as long as palpus. **Cibarial armature** (Fig. 15B). Cibarial bar with about 50 narrow and pointed teeth, all equal, in a row which is weakly convex in middle and slightly concave towards lateral flanges. **Thorax.** Scutal integument and scales brown to dark brown; acrostichal bristles very well developed, in 2 closed rows on anterior half of scutal disc, sometimes extending to prescutellar space; dorso-central bristles very strong; pleuron same color as scutum, usually devoid of scales, sometimes a few pale ovate scales present on propleuron and upper corner of *stp*; 1 lower *mep* bristle usually present, sometimes absent. **Legs.** Anterior surface of hind femur almost entirely pale. **Wing.** Plume scales narrow, linear and moderately dense on all veins. **Abdomen.** Terga dark scaled; sterna paler scaled or as dark as terga.

MALE. In general as described for female; very similar to members of the *tenuipalpis* subgroup, differing from them as in the following. **Head.** Pal-

pus more slender, about 0.5 of proboscis in length; labial false joint absent; flagellar whorls of antenna weakly to moderately plumose, normal large whorls with 15-25 long hairs, minor whorls with 7-8 short hairs. *Terminalia* (Fig. 15A). Terga and sterna of segment IX darker, more strongly sclerotized, tergal lobes prominent, close together near midline, each bears 9-12 strong setae; basimere abnormally large, broad rectangular in shape, inner tergal surface with 4-5 moderately long submarginal setae; subapical lobe very broad and prominent, proximal division with 3 rods, 1 of which is straight with expanded truncate apex, 1 wavy in outline with gently hooked apex and 1 elbow-like with expanded truncate apex, distal division with a strong flattened basal seta laterally and a cluster of 4-5 strong blade-like setae and 1 large odd-shaped blade mesally; distimere large and strongly modified, basal half narrow, apical half expanded, ending in a broad truncate, recurved apex, subapical claw short and very small, ventral subapical seta present or absent, dorsal subapical seta minute, usually present; phallosome dark, strongly sclerotized, broad oval in shape, lateral plate with 6-7 heavy denticles and a few weak and small denticles; proctiger crown dark, medium sized, consisting of several strong spicules, lateral paraproct and cercal sclerite dark, strongly sclerotized, cercal setae 3-5 in number.

PUPA (Fig. 16A). Abdomen 2.0 mm, paddle 0.6 mm, trumpet 0.5 mm, index 7. Chaetotaxy as figured, very similar to *hayashii* in the *tenuipalpis* subgroup, differing in the following. *Cephalothorax* and *Metanotum*. Hair 7-C single; 9-C single; 11-C single or double. *Abdomen*. Hairs 1-IV-VII 4, 2, 2, and 2b respectively; 5-IV-VI double, all subequal in length, slightly longer than the segment following; 6-III-VI double. *Paddle*. Male genital lobe large, about 0.5 of paddle length.

LARVA (Fig. 16B). Head 0.85 mm, siphon 1.2 mm, index 7, saddle 0.32 mm, siphon/saddle ratio 3-4. Very similar to *hayashii* in the *tenuipalpis* subgroup, differing particularly in the following. *Head*. Antennal shaft usually entirely dark; head capsule with more striking pattern of dark and light areas. *Thorax*. Hair 4-P usually single, rarely double; 7-P single. *Abdomen*. Hairs 6-III-VI double. *Siphon*. Darker, concolorous with dark areas on head; length and index greater. *Anal segment*. Same color as siphon; hair 2-X usually single (1-2).

TYPE DATA. (1) *Culex (N.) okinawae* Bohart 1953, holotype: male with slide of terminalia, East Taira, Okinawa, RYUKYU ISLANDS, 21 September, 1951, R. Bohart (USNM). (2) *Culex (N.) lini* Lien 1968, holotype: male (62249.9) with larval and pupal skins and allotype: female (62249.10) with larval and pupal skins, pool on stream bed, Chulu (800 m), Peinan, Taitung Hsien, TAIWAN, 10 December 1961, J. C. Lien and L. C. Lu (Taiwan Provincial Malaria Research Institute, Nankang, Taipei, Taiwan, Republic of China).

DISTRIBUTION. Known only from the Ryukyu Islands, Taiwan and the Philippines. Material examined: 12♂, 11♀, 13 L; 3 with associated lp skins.

RYUKYU ISLANDS. *Okinawa*: East Taira (Type Locality); 1 mi north of Arokawa; 2♂, 4 L. *Iriomote*: 1 1/2 mi south of Sonai village, 1♂, 4 L, 1 lp.

TAIWAN. *Chulu*: Peinan, Taitung Hsien, 1♂, 1♀, 2 lp.

PHILIPPINES. *Luzon*: Trinidad Mountain Province; San Fernando; 10♂, 10♀, 5 L.

TAXONOMIC DISCUSSION. I have compared 1 male and 1 female paratype of *lini* Lien 1968 from Taiwan with the type and other topotypic material of *okinawae* and found them identical in all stages. Accordingly, I am synonymizing *lini* with *okinawae*. The record of this species from the Philippines is based on the adult specimens previously misidentified as *C. brevipalpis* in the collection of the U. S. National Museum.

The adults of *okinawae* are variable in size. The Philippine specimens are apparently larger than those from the Ryukyu Islands and Taiwan. There is, however, no indication of differentiation in the male characters of all specimens which I have examined. The male of *okinawae* is similar to *tenuipalpis*, *richei* and *hayashii* in having a long palpus about 0.5 of the proboscis length

but is strongly differentiated from them in several features of the terminalia as described above. The female cibarial armature is closely similar to that of *hayashii* and is apparently indistinguishable from the latter except through correlation with the immature stages and the male. This species is probably derived from members of the *tenuipalpis* subgroup through geographical isolation.

BIOLOGY. The breeding habitat of *okinawae* includes rock pools and ground pools in the vicinity of streams. The collections of the specimens from the reported areas were made at a relatively high altitude. Nothing is known about the adult biology.

iphis subgroup

C. iphis is treated here as a distinct subgroup separated from the *tenuipalpis* subgroup on the basis of differences in several features of the male terminalia and plumosity of the male antennal flagellar whorls. The subgroup characters are given below in the description of *iphis*. The breeding habitat of this species is unknown. The adults were collected from a high elevation and at present *iphis* is known only from the southern part of India.

25. *Culex (Eumelanomyia) iphis* Barraud (Fig. 15C, ♂ terminalia)

Culex iphis Barraud 1924a, Indian J. med. Res. 11: 1279 (♂*, ♀).

Culex (Mochthogenes) iphis, Edwards 1932, in Wytsman, Genera Insect., fasc. 194: 195 (taxonomy); Barraud 1934, Fauna Brit. India, Diptera 5: 354 (♂*, ♀).

Culex (Eumelanomyia) iphis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Wing 3.9 mm, fore femur 2.1 mm, proboscis 2.4 mm, abdomen 2.7 mm. A rather large species for the subgenus; color dark brown. **Head.** Decumbent scales on dorsum of vertex narrow, linear and predominantly pale yellowish; lateral patch of broad appressed scales bluish white; erect scales entirely dark; palpus about 0.2 of proboscis length; labial basal setae 4 in number, all dark and subequal, nearly as long as palpus. *Cibarial armature* (Fig. 15D). As figured, cibarial bar small, with about 30-40 narrow pointed teeth in a concave row. **Thorax.** Scutal integument dark brown, scutal scales narrow, predominantly dark except for a few pale ones on extreme anterior promontory and anterior margin of fossa; acrostichal bristles present, widely spaced; pleuron same color as scutum; upper corner of *stp* with or without a few pale translucent scales; 1 lower *mep* bristle present, sometimes 2. **Legs.** Anterior surface of hind femur with a pale white stripe extending from base to about 0.75 of the whole length, apical 0.25 dark; all tibiae and tarsi dark. **Wing.** Plume scales narrow, long and very dense on all veins. **Abdomen.** Terga entirely dark scaled; sterna pale yellowish scaled.

MALE. In general similar to female with the following diagnostic features. **Head.** Palpus about 0.2 of proboscis length; labial basal setae about 6 in number, all dark, subequal, about 0.75 of palpal length; flagellar whorls of antenna strong but rather sparse, normal whorls with about 15 hairs, minor whorls with about 5 hairs. **Terminalia** (Fig. 15C). Tergal lobe of segment IX well developed, with 12-15 moderately strong setae; basimere small, typically cone-shaped, inner tergal surface with a linear row of 4-6 strong, flattened submarginal setae, tergomesal margin with several short, strong marginal setae; subapical lobe clearly divided into proximal and distal divisions, proximal division with 3 rather short rods, 2 of which are stout with truncate apices, 1 slender with hooked and pointed apex, distal division with a strongly chitinated narrow leaflet laterally and a distinct mesal lobe which bears 2-3 strong setae

and 1 lanceolate blade-like seta; distimere sickle-shaped, basal half broad, uniformly thick, apical half tapered to truncate apex which is strongly recurved dorsally, subapical claw strong, spiniform, ventral subapical seta distinct, placed near middle of curvature, dorsal subapical seta minute, distad of ventral; lateral plate of phallosome strongly sclerotized, more or less triangular-shaped, 15-16 strong denticles present on its upper tergal surface; proctiger crown dark, medium or large in size, consisting of 6-7 flat and apically blunt spicules laterally and several finer spine-like spicules internally; 3 cercal setae present.

PUPA and LARVA. Unknown.

TYPE DATA. Lectotype: male, Nilgiri Hills, Madras, INDIA, September 1915, Khazan Chand (BM). PRESENT SELECTION.

DISTRIBUTION. Known only from the type locality in India. Material examined: 6♂, 5♀.

TAXONOMIC DISCUSSION. The original description of *iphis* by Barraud (1924) was based on both sexes but no holotype was selected. In view of this, I therefore selected 1 male in the type series as the lectotype. The above description of this species is based exclusively on the material in the original type series. All of these specimens agree well with the description and figures by Barraud (1924a, 1934).

C. iphis is very distinct from other members of the *mochthogenes* group in several features of the male terminalia and on this basis, I am placing it in a subgroup of its own. The adults of *iphis* are generally similar to those in the *tenuipalpis* subgroup from which it is distinguished in the female by the presence of smaller number of cibarial teeth and in the male by the less plumose flagellar whorls of the antenna, the palpus as short as in the female, and by details of the terminalia as indicated in the key and in the above description. The lateral plate of the male phallosome of *iphis* is rather unique, in being more or less triangular, showing similarity to that of the Ethiopian *horridus* (Edwards 1941: 296-270). The affinities of *iphis* with the other Oriental species as well as with the Ethiopian *horridus* will not be clear until its immatures are known.

BIOLOGY. The breeding habitat of *iphis* is not yet known. In the type locality in India the adults were collected at a high elevation.

bokorensis subgroup

The *bokorensis* subgroup is recognized here to include only *bokorensis* Klein and Sirivanakarn 1969 and is characterized below in the description of this species. In the earlier paper (Sirivanakarn 1971), I placed this species with the Ethiopian forms in the *inconspicuus* subgroup. However, after having compared the *bokorensis* male with some members of that subgroup, I found it so distinct in several features of the terminalia that I now feel justified in placing this species within its own subgroup. This subgroup is known only from Cambodia.

26. *Culex (Eumelanomyia) bokorensis* Klein and Sirivanakarn (Fig. 17A, ♂ terminalia)

Culex (Mochthogenes) bokorensis Klein and Sirivanakarn 1969, Proc. ent. Soc. Wash., 71: 587 ().

Culex (Eumelanomyia) bokorensis, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy)

FEMALE. Unknown.

MALE. Essentially as described and figured by Klein and Sirivanakarn (1969: 587-589) and as in the following redescription. *Head*. Decumbent scales on dorsum of vertex narrow, predominantly yellowish; lateral patch of broad appressed scales pale along eye margin, grayish or dark posteriorly;

erect scales entirely dark; palpus thin, about 0.2 of proboscis length; proboscis slender, false joint absent, labial basal setae about 4 in number, all dark, hair-like, as long as palpus; flagellar whorls of antenna moderately long plumose, normal whorls with 15-20 hairs, minor whorls with about 8 hairs.

Thorax. Scutal integument dark brown; scutal scales narrow, rather fine and nearly black; acrostichal bristles few, only 2-3 pairs present in middle of scutal disc; pleuron same color as scutum; scales absent; 1 lower *met* bristle present. *Legs*. Anterior surface of hind femur pale whitish from base to apex; all tibiae and tarsi dark to black scaled. *Wing*. Plume scales narrow, black and moderately dense on all veins. *Abdomen*. Rather narrow and long, terga and sterna dark brown to black scaled. *Terminalia* (Fig. 17A). Most distinctive; tergal lobe of segment IX very small, with 2-3 tiny setae; basimere large, strongly sclerotized, sacklike in shape, lateral tergal margin strongly swollen basally, narrow apically, inner tergal surface convex, with several strong bristles from near base to the level of the subapical lobe, bristles on lateral tergal surface numerous and very strong; subapical lobe prominent, proximal division produced into an elongate stem which bears on its apex 1 very thick, dark and apically blunt rod and 2 slender rods, its base with 1 broad acuminate leaflet, 1 very long seta and 3-4 other shorter strong setae, distal division with 1 strong simple seta and 4 strong, blunt tipped blades some of which are serrated subapically; distimere thick, with pronounced angle at middle dorsally, basal half thick, apical half scooped downwards and tapered into small, blunt apex, subapical claw small and short, 1 or 2 tiny subapical setae present beyond middle ventrally and laterally; lateral plate of phallosome dark brown, heavily sclerotized, broad oval, tapered distally into a blunt apex, several strong denticles present; proctiger crown dark, medium or large sized, consisting of several strong spinelike and some blunt tipped spicules, lateral paraproct and cercal sclerite dark, 2-3 cercal setae present.

PUPA and LARVA. Unknown.

TYPE DATA. Holotype: male (386) with slide of terminalia, Bokor hill, Kampong, CAMBODIA, 24 April 1968, J. M. Klein (USNM).

DISTRIBUTION. Known only from the type locality in Cambodia. Material examined: 6♂.

TAXONOMIC DISCUSSION. *C. bokorensis* is generally very similar to *hackeri* and *kiriensis* of the *tenuipalpis* subgroup but is strikingly differentiated from them by the spectacular modification of the basimere and distimere of the male terminalia. It can be readily recognized in general by the presence of only a few acrostichal bristles on the scutal disc and in the male terminalia by several features of the basimere, distimere and phallosome as indicated in the key and as described above. The male terminalia of *bokorensis* is apparently rather similar to the *inconspicuus* subgroup (see Edwards 1941: 277-279) in the shape of the distimere, but differs significantly in having the claw placed subapically instead of mid-dorsally as in all members of that subgroup. There are also several other fundamental differences in the male terminalia which justify placing *bokorensis* in a distinct subgroup of its own. The relationship between *bokorensis* and other species in the Oriental region can not be determined or speculated on until the immature stages are known.

BIOLOGY. The males of *bokorensis* were collected along the margin of a stream under heavy shade of a tropical forest at an altitude between 300-800 m. At the type locality, the specimens were found in association with those of *kiriensis*. Nothing is known about its breeding site and adult biology.

otachati subgroup

The *otachati* subgroup is strongly differentiated from the other subgroups of the *mochthogenes* group in the shape of the lateral plate of the male phallosome as indicated in the key and as described below. Except for its very distinctive male phallosome, this species generally conforms to the *mochthogenes* group characters. At present it has been recorded only from Cambodia and Thailand.

27. *Culex (Eumelanomyia) otachati* Klein and Sirivanakarn
(Fig. 17B, ♂ terminalia)

Culex (Mochthogenes) otachati Klein and Sirivanakarn 1969, Proc. ent. Soc. Wash., 71: 585 (♂).

Culex (Eumelanomyia) otachati, Sirivanakarn 1971, Contrib. Amer. Ent. Inst. 7: 62-85 (taxonomy).

FEMALE. Unknown.

MALE. As described by Klein and Sirivanakarn (1969: 585-587) and as in the following redescription. Rather small, dark brown to black species; wing length about 2.2 mm. *Head*. Decumbent scales on anterior eye margin of vertex broad and pale, forming a narrow distinct ocular line; decumbent scales in center narrow, yellow, more or less restricted to dorsal midline; erect scales slender, entirely brownish; lateral patch of broad appressed scales dingy white or grayish; palpus a little less than 0.2 of proboscis length; false joint present at about middle of labium; labial basal setae 10 in number, all dark, hair-like and long, about 1.5 times as long as palpus; flagellar whorls of antenna weakly plumose, normal large whorls with about 15 hairs, minor whorls with 8-10 hairs. *Thorax*. Scutal integument dark brown; scutal scales narrow, fine and entirely dark; acrostichal bristles present; dorsocentral bristles very strong and long; pleuron with striking pattern of dark and light areas; scales entirely absent; 1 lower *me* bristle present. *Legs*. All femora, tibiae and tarsi entirely dark scaled. *Wing*. Plume scales small, clavate and moderately dense on all veins. *Abdomen*. Terga and sterna very dark to black scaled. *Terminalia* (Fig. 17B). In general rather small; tergal lobe of segment IX poorly developed, with a row of 4-7 weak and short setae; basimere slender, roughly conical, about 0.2 mm in length, inner tergal surface without strong submarginal setae, strong bristles largely confined to lateral tergal surface; setae of subapical lobe clearly aggregated into proximal and distal divisions, proximal division with 3 subequal rods, all apparently with truncate apices, distal division with 1 strong basal seta and a dense group of 4-5 acute flattened setae and 4 club-shaped blades, the 2 most distal of which are provided with coarse fringes of spicules along the margins; distimere sickle-shaped, about 0.5 of the length of basimere, dorsal surface with 1-2 small scale-like setae near middle of curvature, distal part tapered to slightly recurved truncate apex, subapical claw long and broad apically, ventral subapical seta present just beyond middle; phallosome deep brown and very strongly sclerotized, distinct in shape, lateral plate thick, rodlike in apical half, apex pointed and diverged laterally, 6-7 strong, heavy tooth-like processes present, restricted to lateral margin, basal part with a broad, dark sternal lobe; proctiger crown dark, size medium or large, consisting of 4-6 flat and blunt spicules laterally and several finer and pointed spicules internally, lateral paraproct and cercal sclerite dark and strongly sclerotized, cercal setae 2 or 3 in number.

PUPA and LARVA. Unknown.

TYPE DATA. Holotype: male (327) with slide of terminalia, Kirirom Hill, O Tachat, *Komlong Speu*, CAMBODIA, 19 April 1968, J. M. Klein (USNM).

DISTRIBUTION. Known only from Cambodia and Thailand. Material examined: 9 ♂.

THAILAND. *Nakhon Ratchasima*: Khao Yai National Forest, 1 ♂.

CAMBODIA. *Komlong Speu*: O Tachat; Pichnil Stung Chral; 8 ♂.

TAXONOMIC DISCUSSION. *C. otachati* superficially resembles the members of the *foliatus* and *hinglungensis* subgroups in size and in general external features but is strongly differentiated from them in the type of phallosome and in several other features of the male terminalia. The affinity of *otachati* with other members of the *mochthogenes* group cannot be determined until its immature stages are known. On the basis of the male terminalia, this species apparently belongs to a subgroup of its own.

BIOLOGY. The adult males of *otachati* were collected while resting on

vegetation along a stream margin under heavy forest shade in hilly or mountainous areas. It appears to be rare and was found in association with specimens of *kiriensis*. The breeding habitat and adult biology are unknown.

28. *Culex (Eumelanomyia) sp.* Philippine form

The Philippine material which is recorded here as sp. 28 consists of 1 correlated pupal and larval skin and 2 whole larvae collected from a rock-hole, No. 599 Osmena, *Samar* by J. Laffoon, dated 27 April 1945 and 4 correlated pupal and larval skins collected from a treehole, No. 1004, Olongapo, *Luzon* by Zolik, dated 25 June 1945. All of these specimens were obtained from the Rozeboom, Knight and Laffoon team collection made during World War II. The associated adults were apparently lost and it is not possible here to associate this material with any of the known adults. The pupa and larva are quite distinct from all known members in the *mochthogenes* group as indicated in the keys. The pupa is very similar to the *malayi* subgroup in general and in most features of the chaetotaxy except for having hair 11-C single. The larva is generally as figured for *C. malayi* however it differs from the latter in having prothoracic hair 3-P 3-4b, 4-P single and as long as 1 or 2-P, 8-P double and in the undifferentiated comb scales.

ACKNOWLEDGMENTS

I wish to express my sincere thanks to the following persons who, in various ways, have provided assistance in completing this study. To Dr. Botha de Meillon, Project Leader, Southeast Asia Mosquito Project for editing, helpful criticisms in improving the manuscript and for nearly all correspondences in obtaining the specimens for study; to Dr. Alan Stone and Dr. Curtis W. Sabrosky, Agriculture Research Service, U. S. Department of Agriculture, for valuable discussions with regard to problems involving type specimens; and for allowing me to use their private libraries and to examine the types at the U. S. National Museum; to Dr. P. F. Mattingly for his promptness in answering questions about types, for his courtesy extended to me while studying specimens at the British Museum and for the loan of specimens; to Thelma Ford for preparation of all illustrations; to Phuang Thong Malikul for technical assistance in preparing terminalia slides and in gathering distribution data and to Mrs. Janet Rupp for typing the final draft for off-set reproduction.

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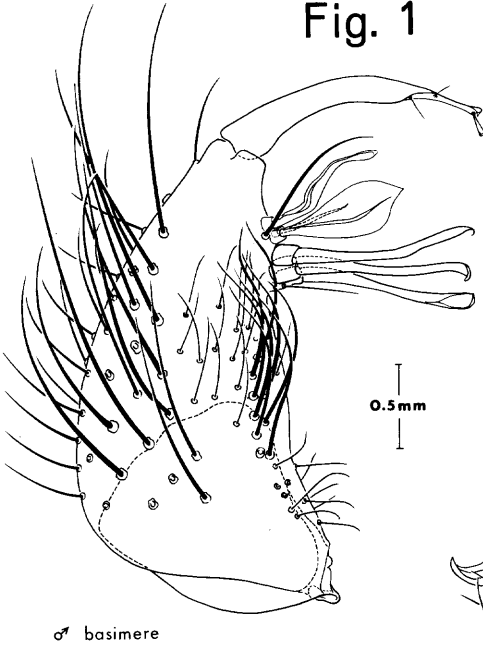
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FIGURES

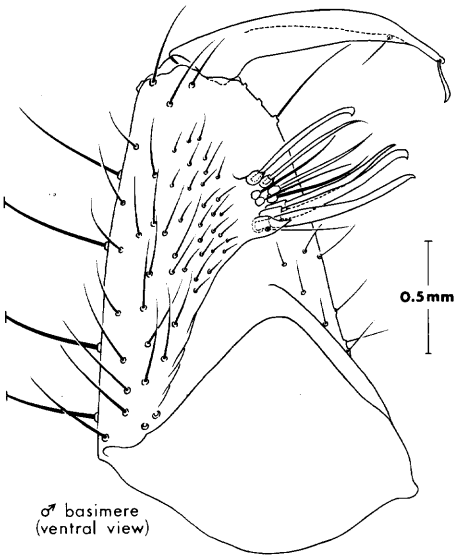
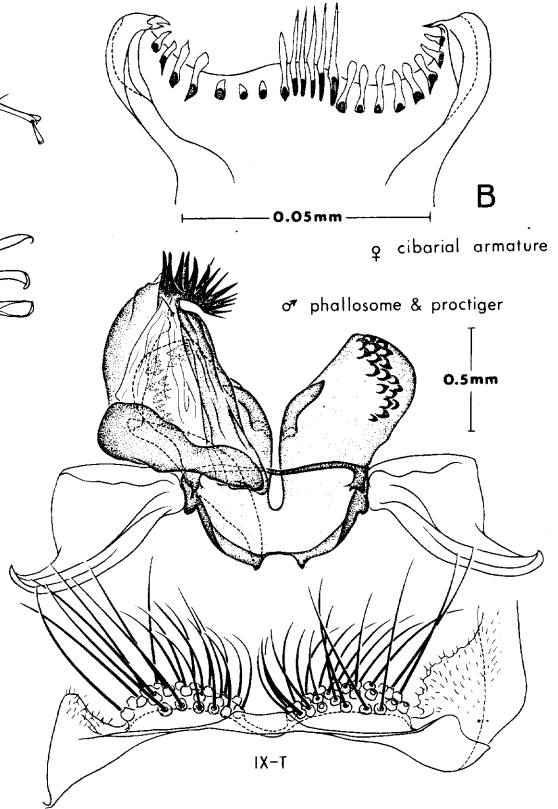
- FIGURE 1. A. Male terminalia of *C. simplicicornis*
B. Female cibarial armature of *C. simplicicornis*
C. Male terminalia of *C. malayensis*
D. Female cibarial armature of *C. malayensis*
- FIGURE 2. A. Male terminalia of *C. brevipalpis*
B. Male antennal flagellum of *C. brevipalpis*
C. Female cibarial armature of *C. brevipalpis*
D. Male terminalia of *C. phangngae*
- FIGURE 3. A. Pupa of *C. brevipalpis*
B. Larva of *C. brevipalpis*
- FIGURE 4. A. Male terminalia of *C. uncinatus*
B. Male terminalia of *C. foliatus*
C. Female cibarial armature of *C. foliatus*
D. Male terminalia of *C. latifolius*
- FIGURE 5. A. Pupa of *C. foliatus*
B. Larva of *C. foliatus*
- FIGURE 6. A. Male terminalia of *C. hinglungensis*
B. Male terminalia of *C. cataractarum*
C. Male terminalia of *C. baisasi*
D. Male terminalia of *C. castrensis*
- FIGURE 7. A. Male terminalia of *C. malayi*
B. Female cibarial armature of *C. malayi*
C. Male terminalia of *C. laureli*
D. Female cibarial armature of *C. laureli*
- FIGURE 8. A. Pupa of *C. malayi*
B. Larva of *C. malayi*
- FIGURE 9. A. Male terminalia of *C. yeageri*
B. Female cibarial armature of *C. yeageri*
C. Male terminalia of *C. pluvialis*
D. Male terminalia of *C. campilunati*
- FIGURE 10. A. Male terminalia of *C. selai*
B. Male terminalia of *C. khazani*
C. Male terminalia of *C. tenuipalpis*
D. Female cibarial armature of *C. tenuipalpis*
- FIGURE 11. A. Pupa of *C. tenuipalpis*
B. Larva of *C. tenuipalpis*
- FIGURE 12. A. Male terminalia of *C. richei*
B. Male terminalia of *C. hayashii*
C. Female cibarial armature of *C. hayashii*
- FIGURE 13. A. Pupa of *C. hayashii*
B. Larva of *C. hayashii*
- FIGURE 14. A. Male terminalia of *C. hackeri*
B. Female cibarial armature of *C. hackeri*
C. Male terminalia of *C. kiriensis*
D. Female cibarial armature of *C. kiriensis*

- FIGURE 15. A. Male terminalia of *C. okinawae*
B. Female cibarial armature of *C. okinawae*
C. Male terminalia of *C. iphis*
D. Female cibarial armature of *C. iphis*
- FIGURE 16. A. Pupa of *C. okinawae*
B. Larva of *C. okinawae*
- FIGURE 17. A. Male terminalia of *C. bokorensis*
B. Male terminalia of *C. otachati*

Fig. 1



C. (Eumelanomyia) simplicicornis



C. (Eumelanomyia) malayensis

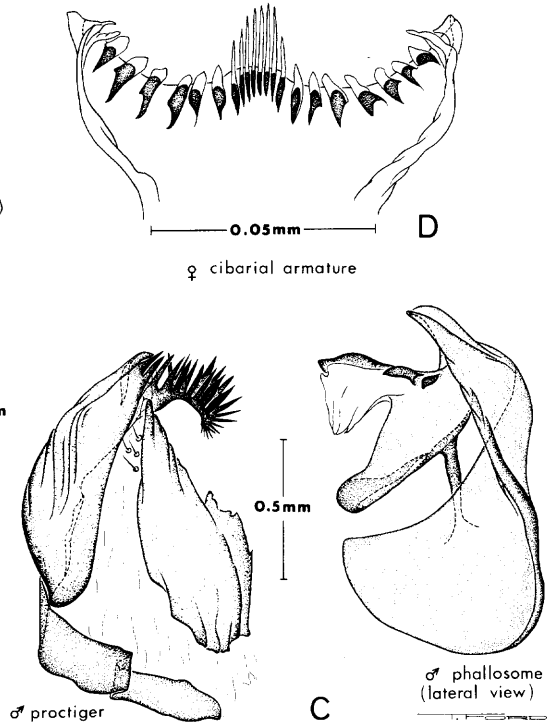


Fig. 2

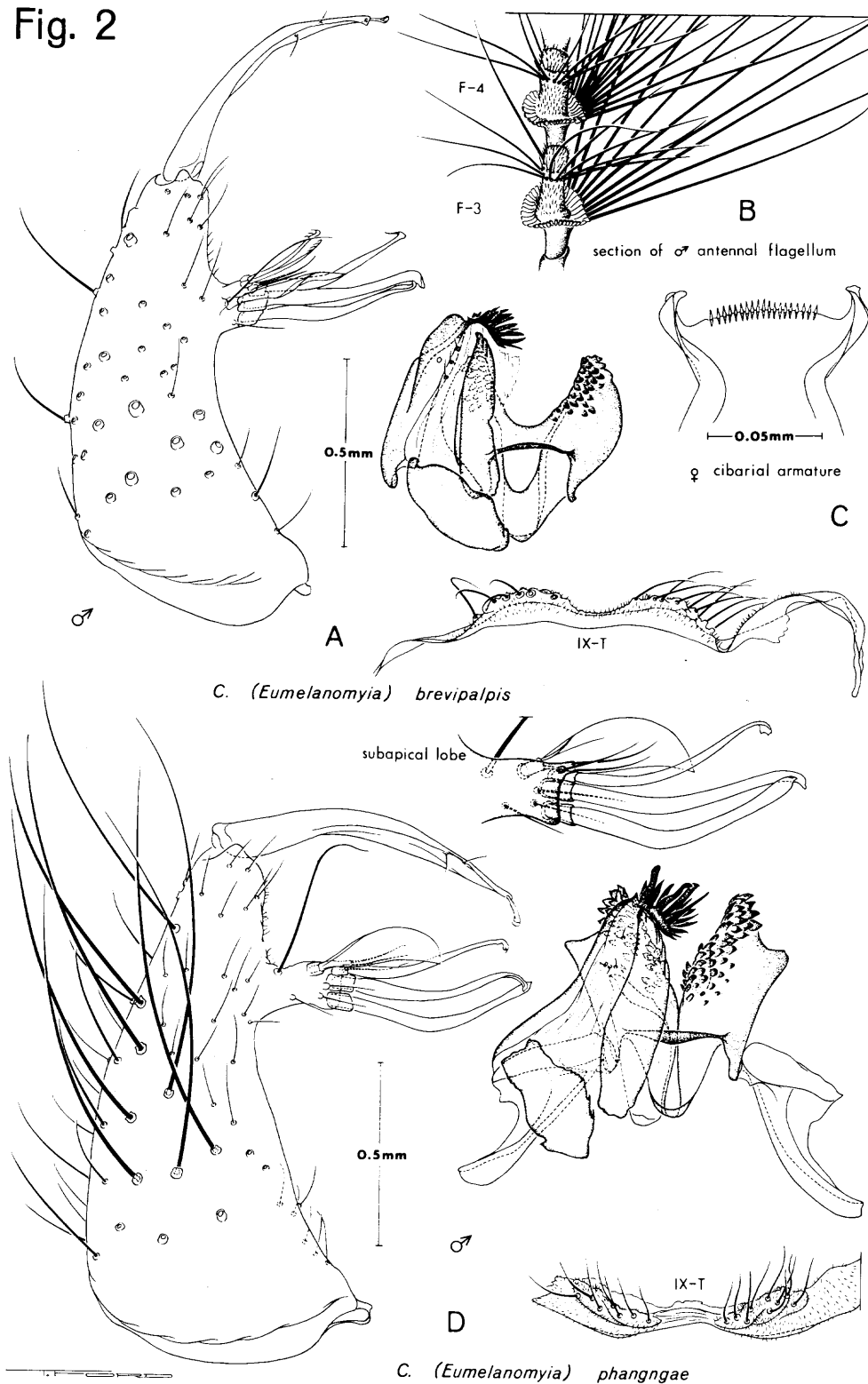
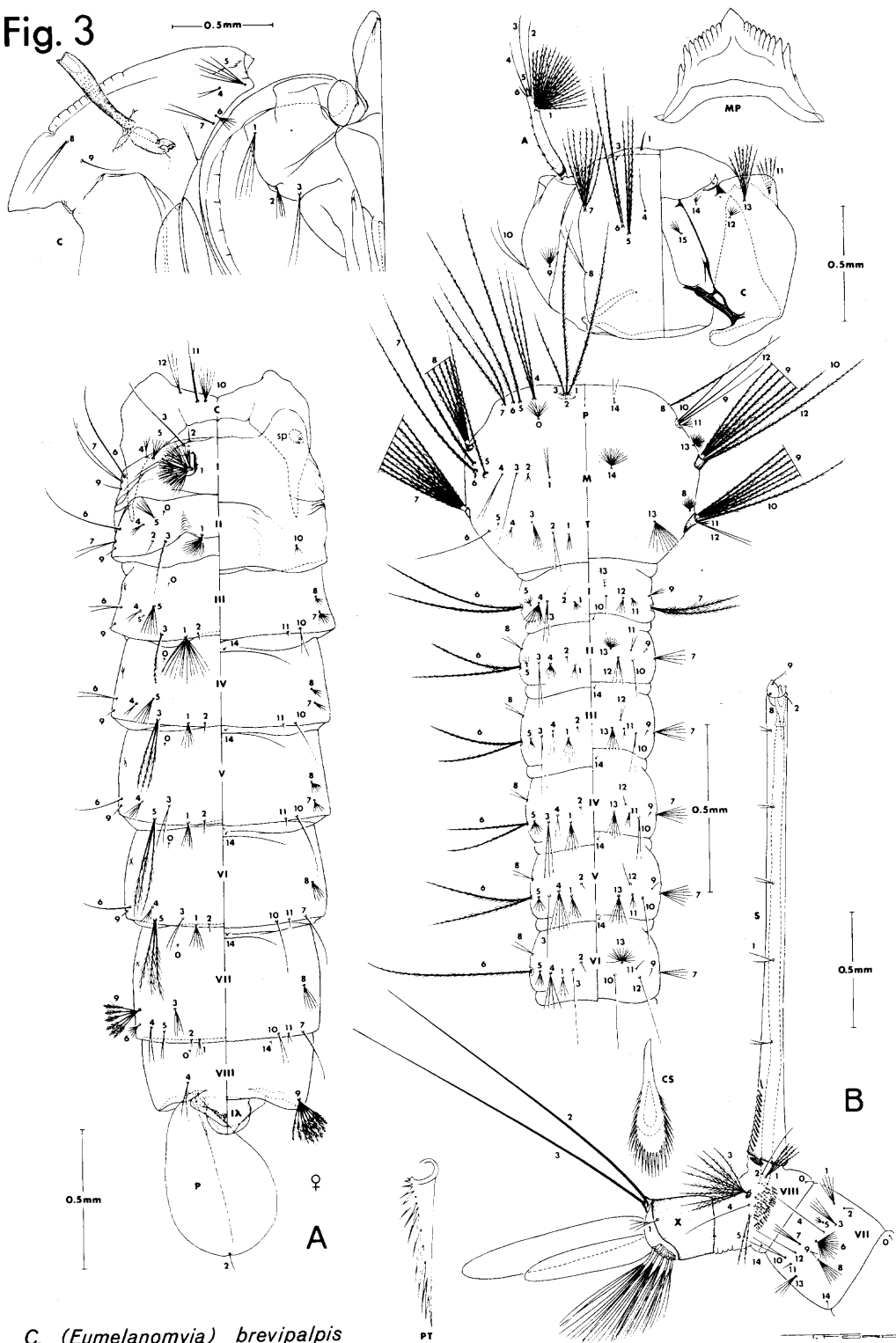


Fig. 3



C. (Eumelanomyia) brevipalpis

Fig. 4

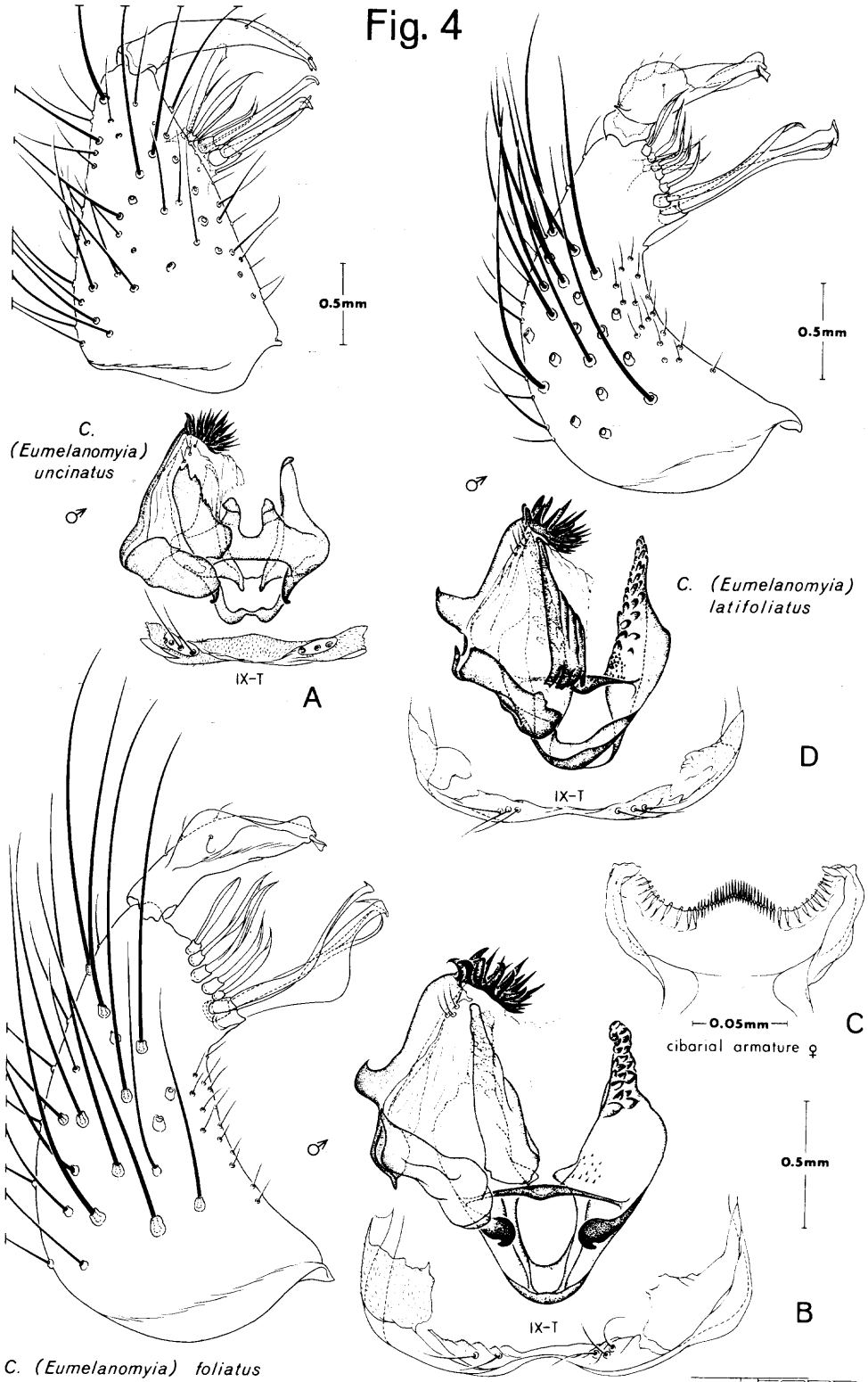
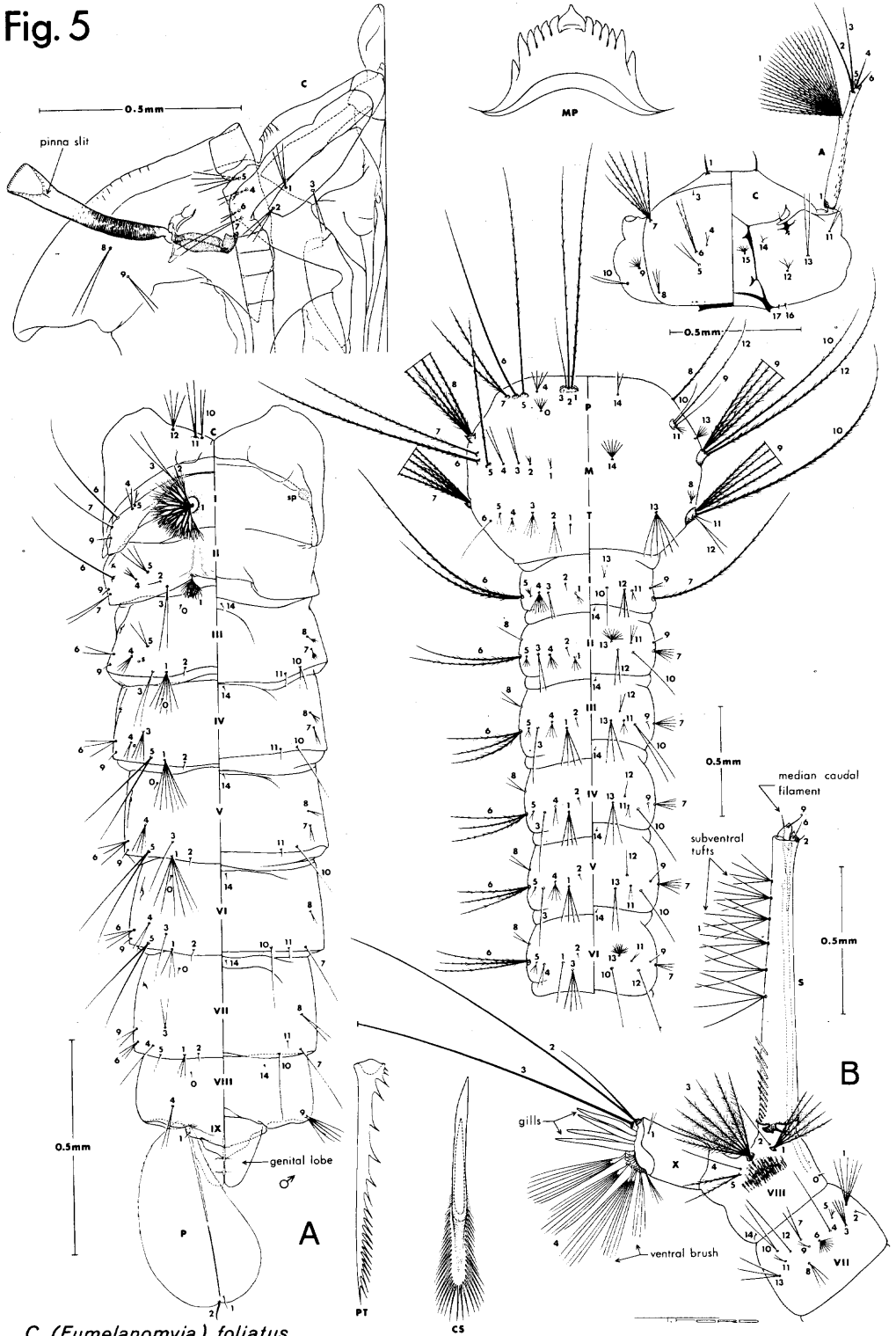


Fig. 5



C. (Eumelanomyia) foliatus

Fig. 6

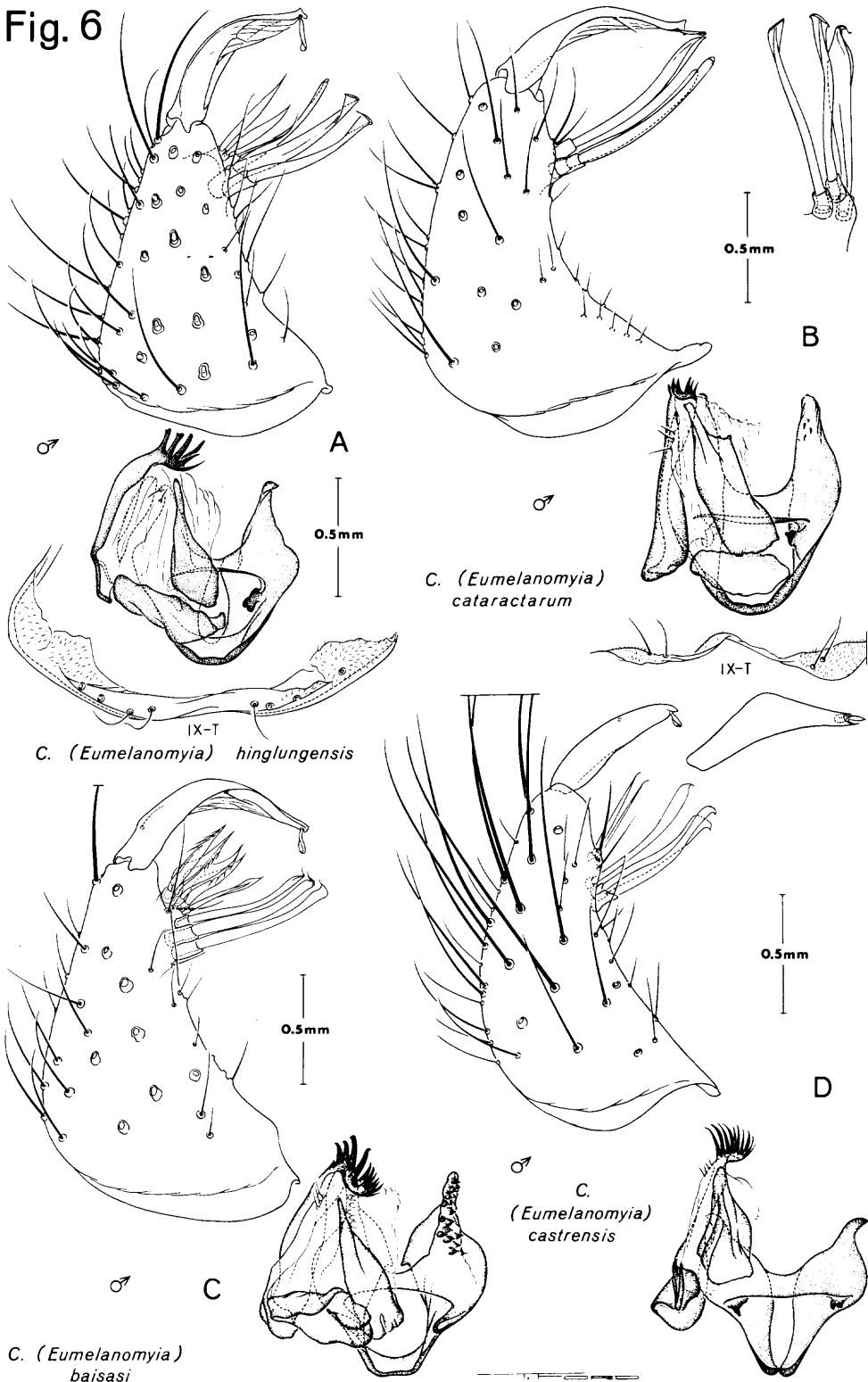
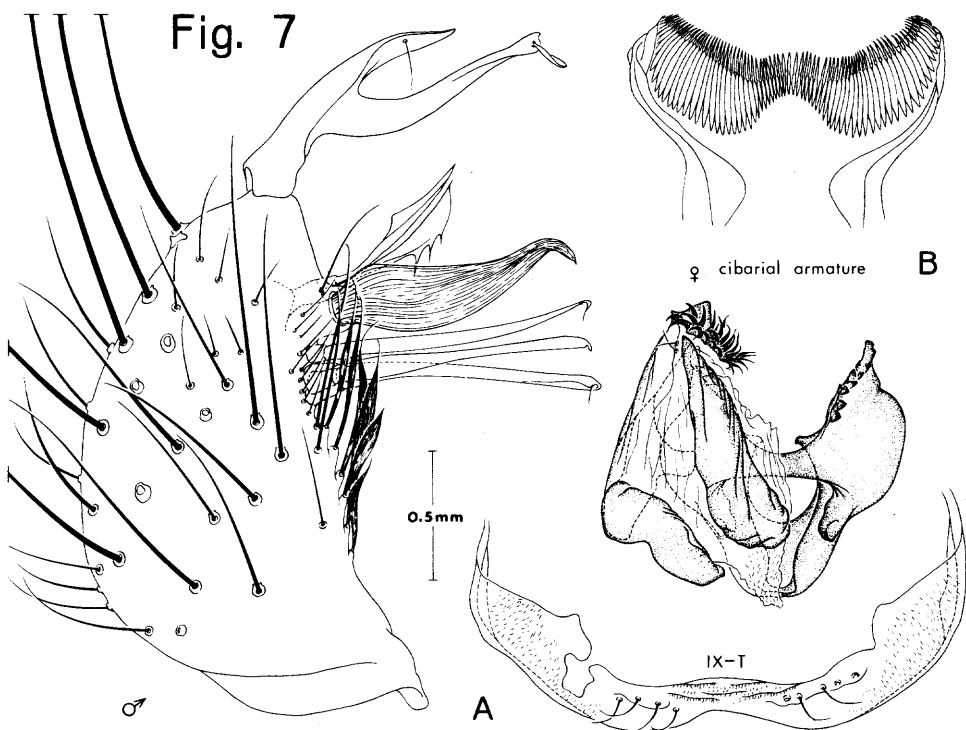
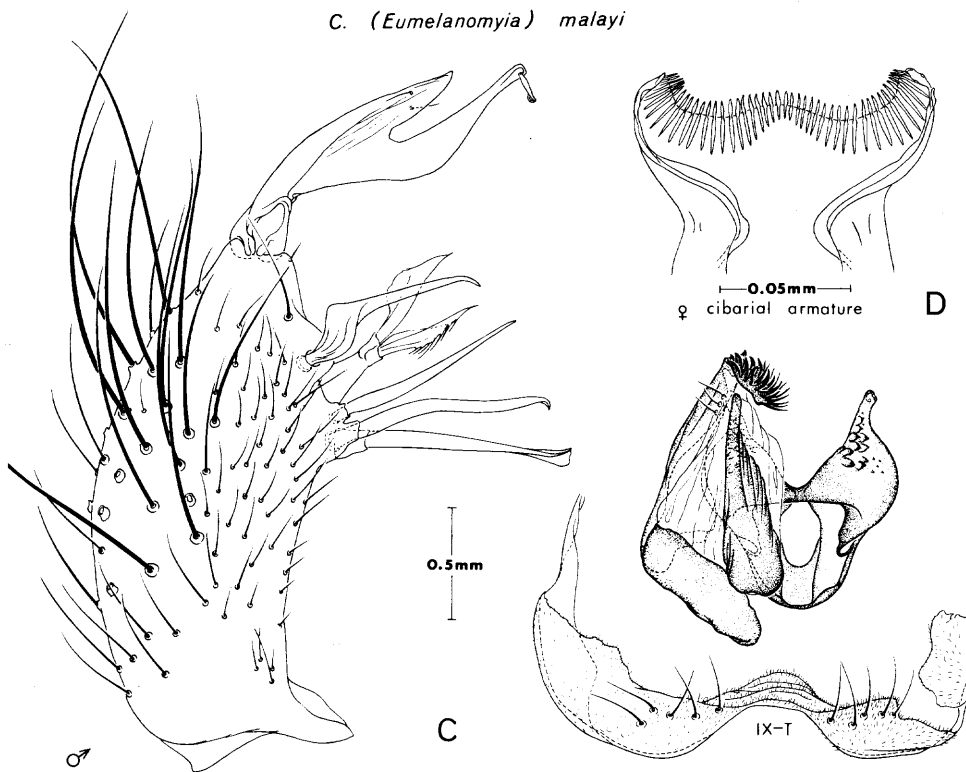


Fig. 7

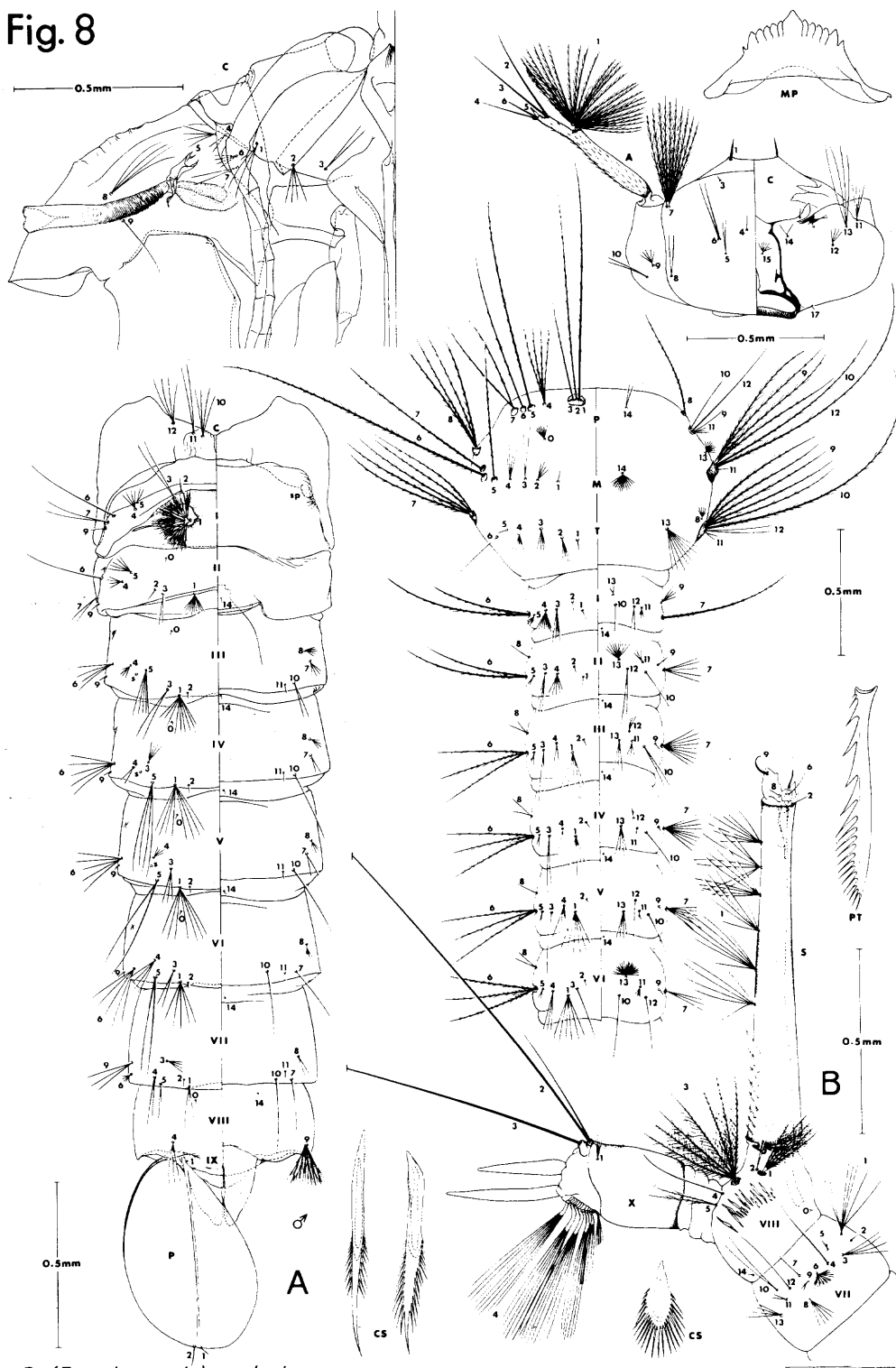


C. (Eumelanomyia) malayi



C. (Eumelanomyia) laureli

Fig. 8



C. (Eumelanomyia) malayi

Fig. 9

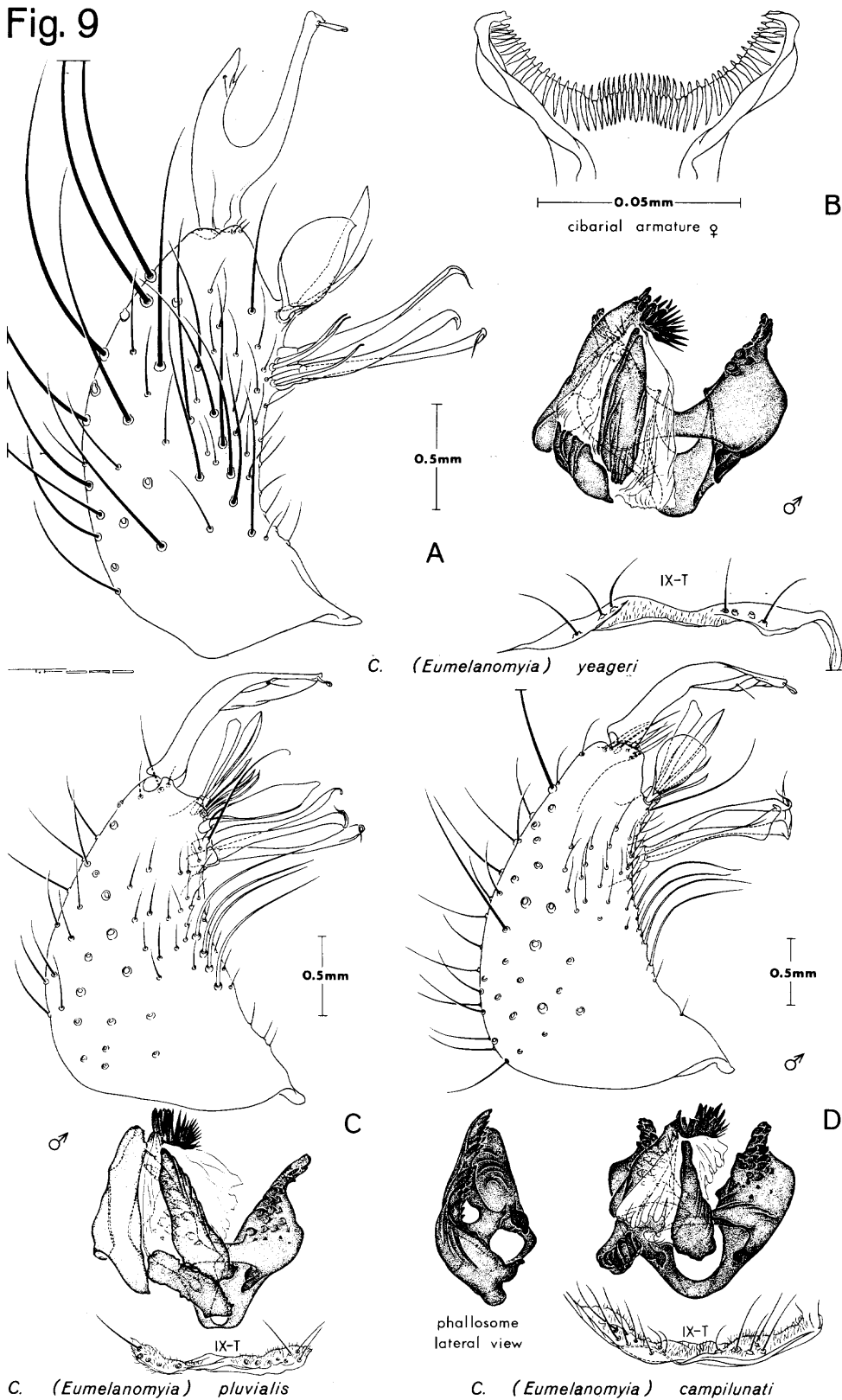


Fig. 10

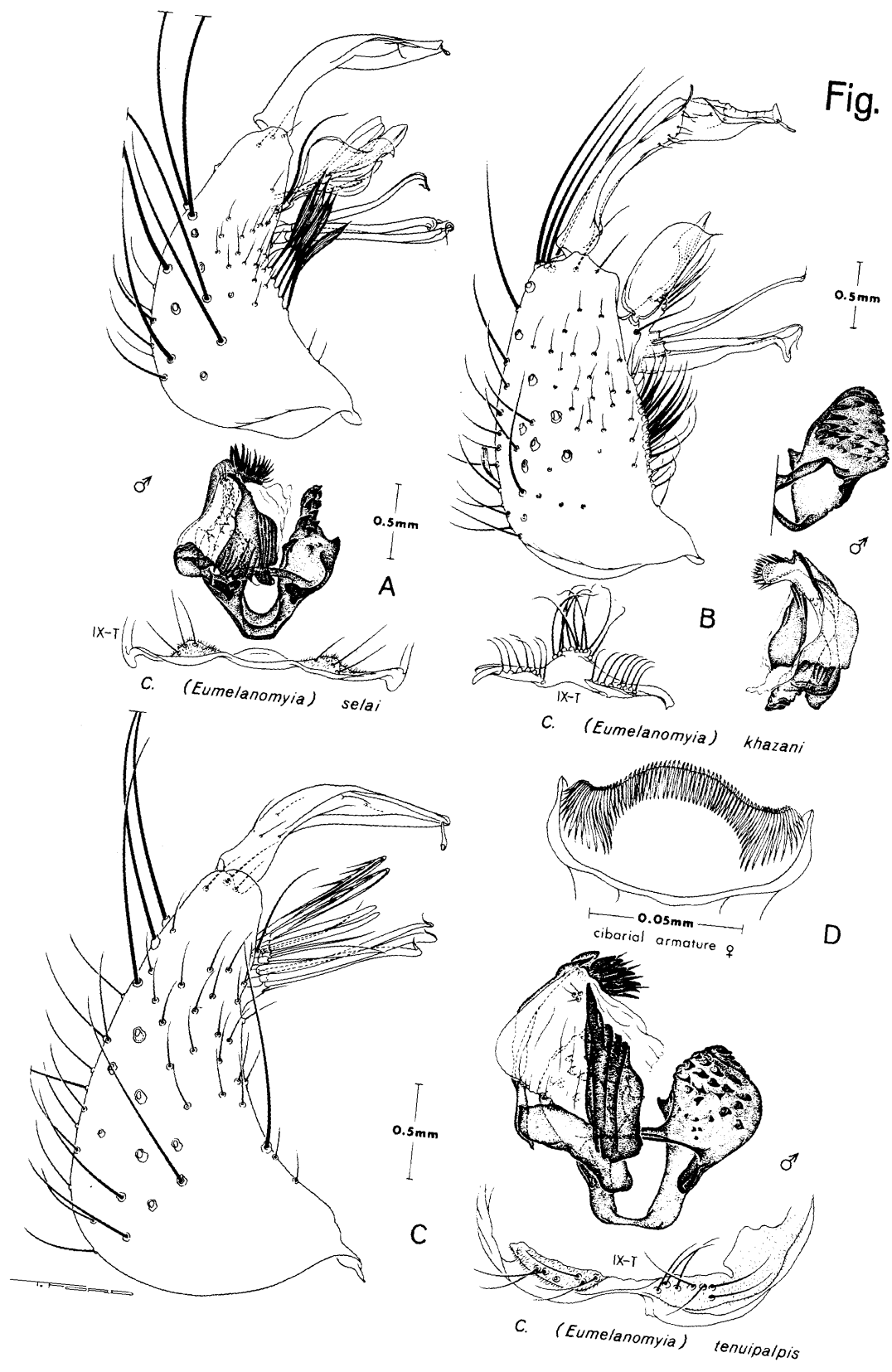
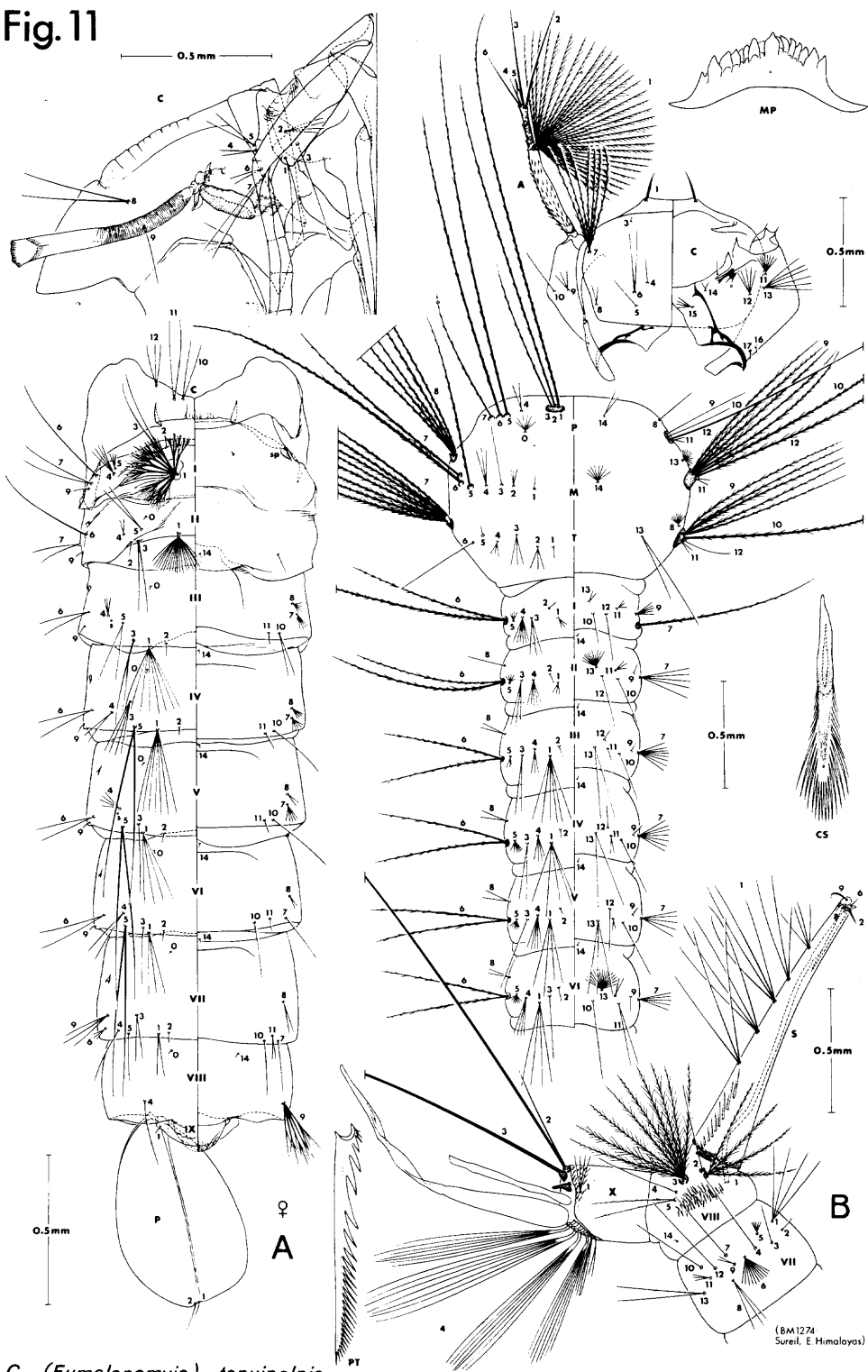
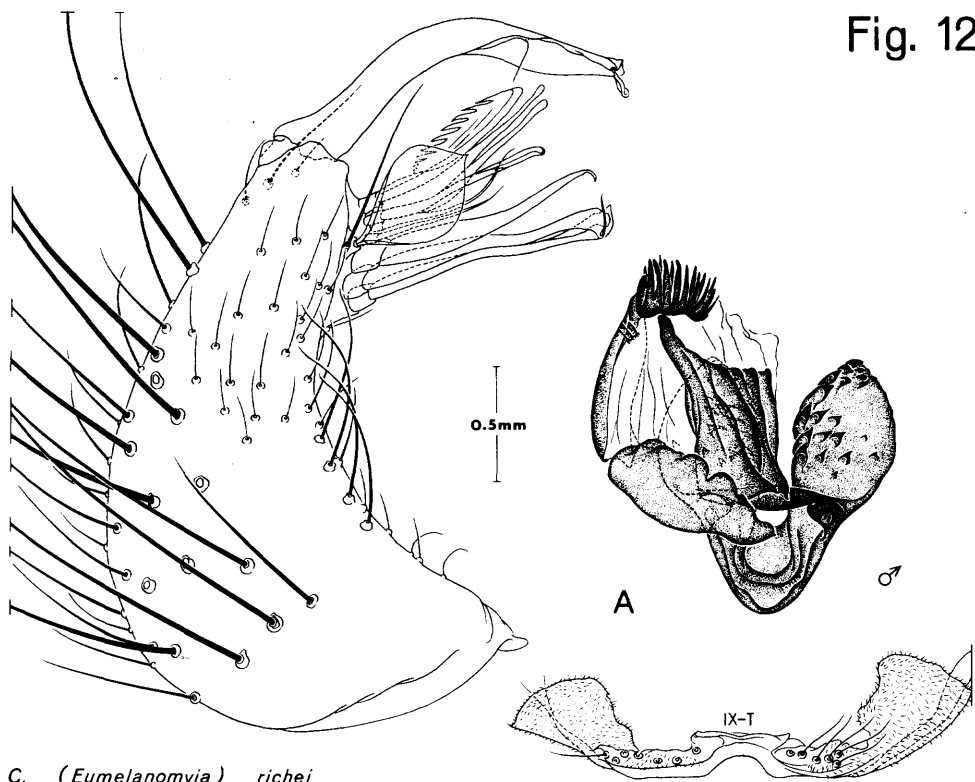


Fig. 11

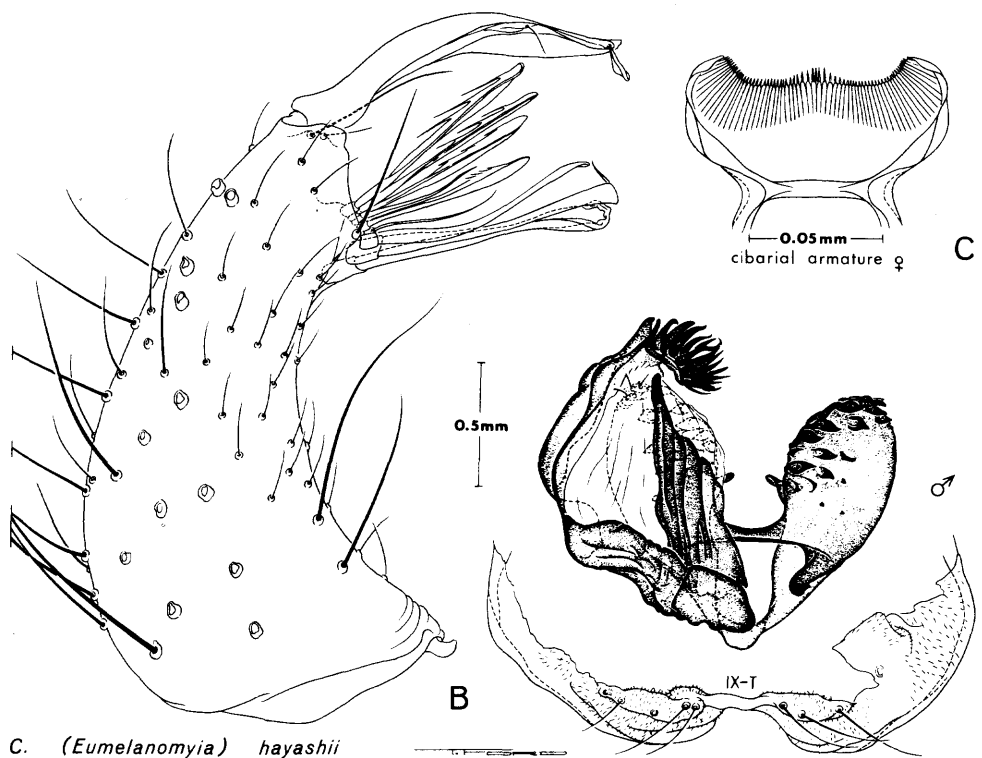


C. (Eumelanomyia) tenuipalpis

Fig. 12

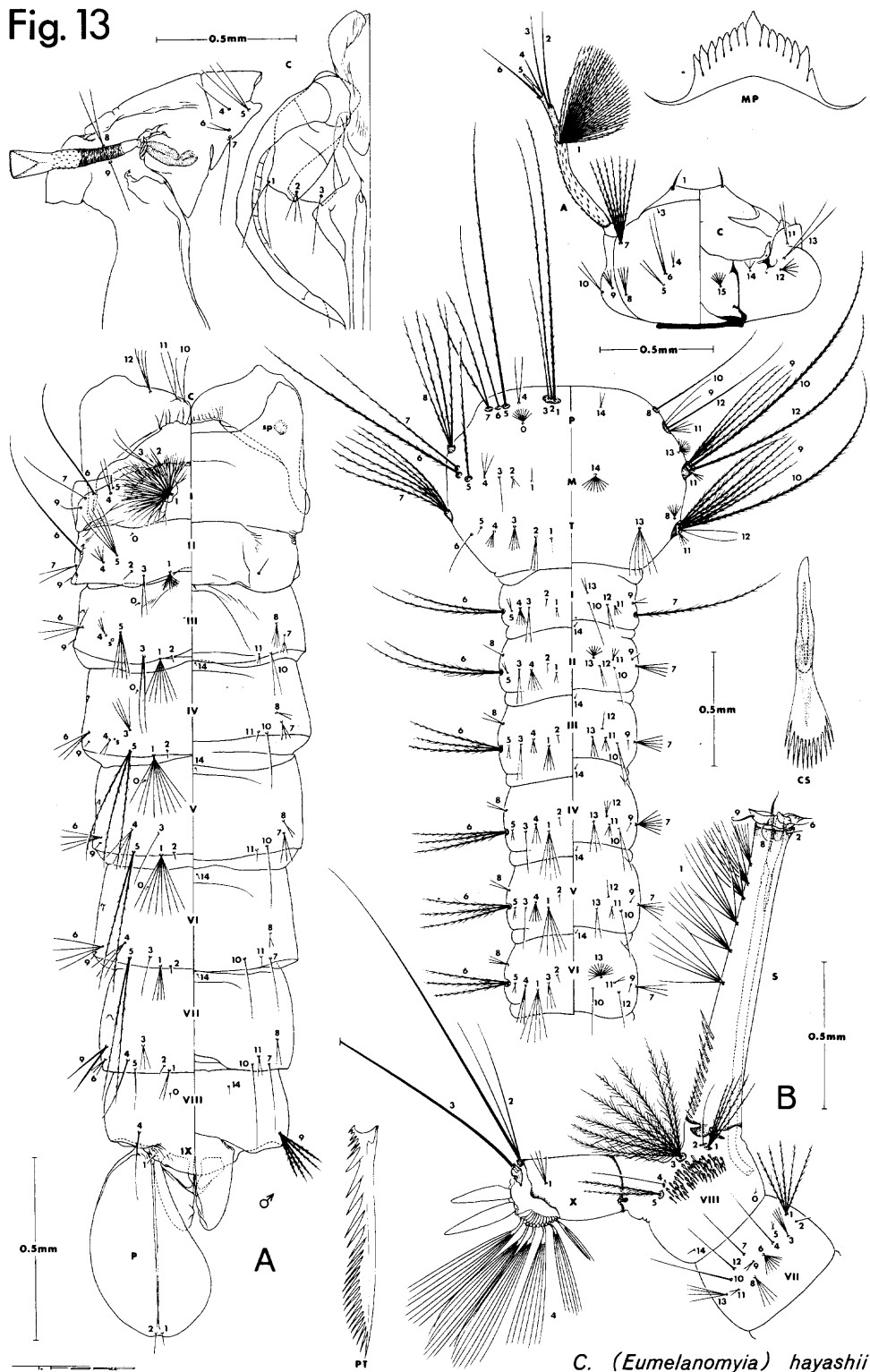


C. (Eumelanomyia) richei



C. (Eumelanomyia) hayashii

Fig. 13



C. (Eumelanomyia) hayashii

Fig.14

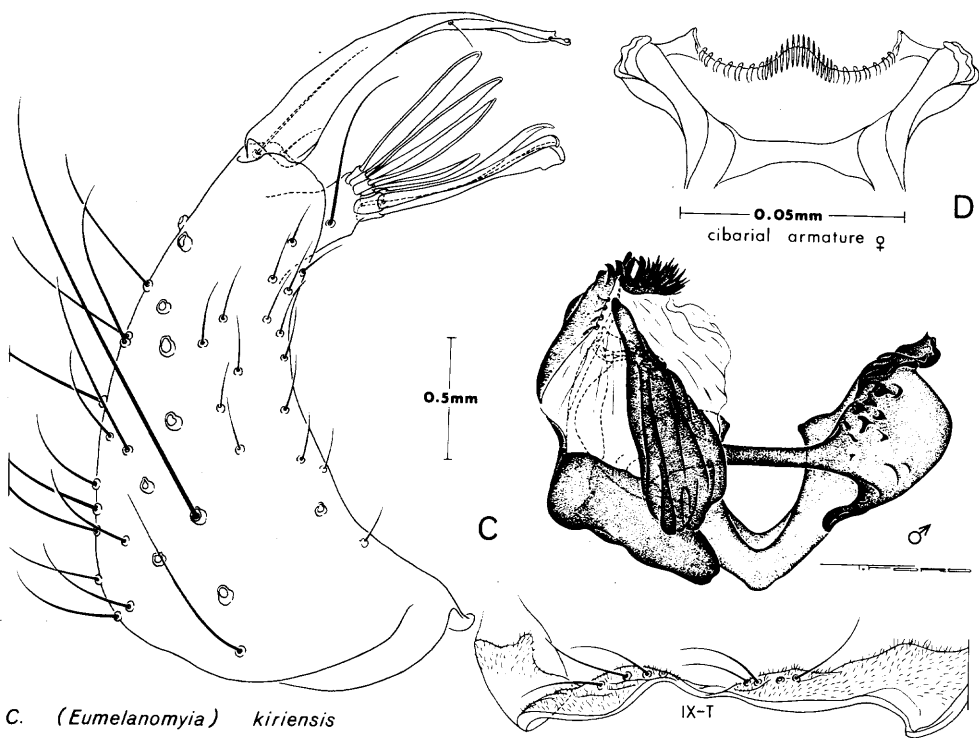
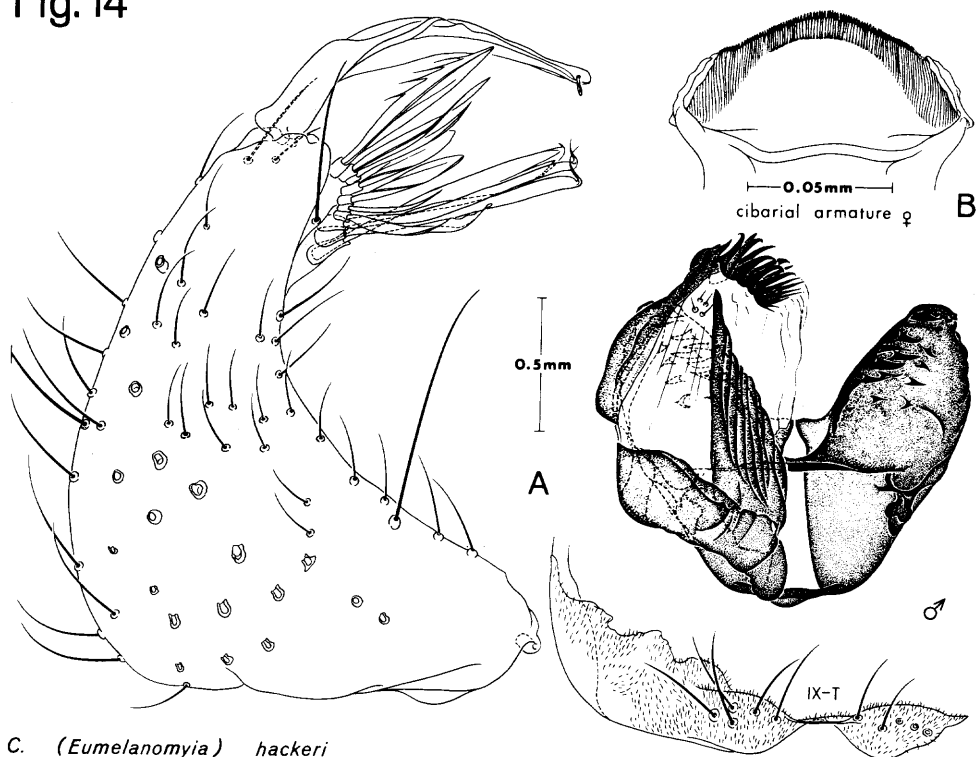


Fig. 15

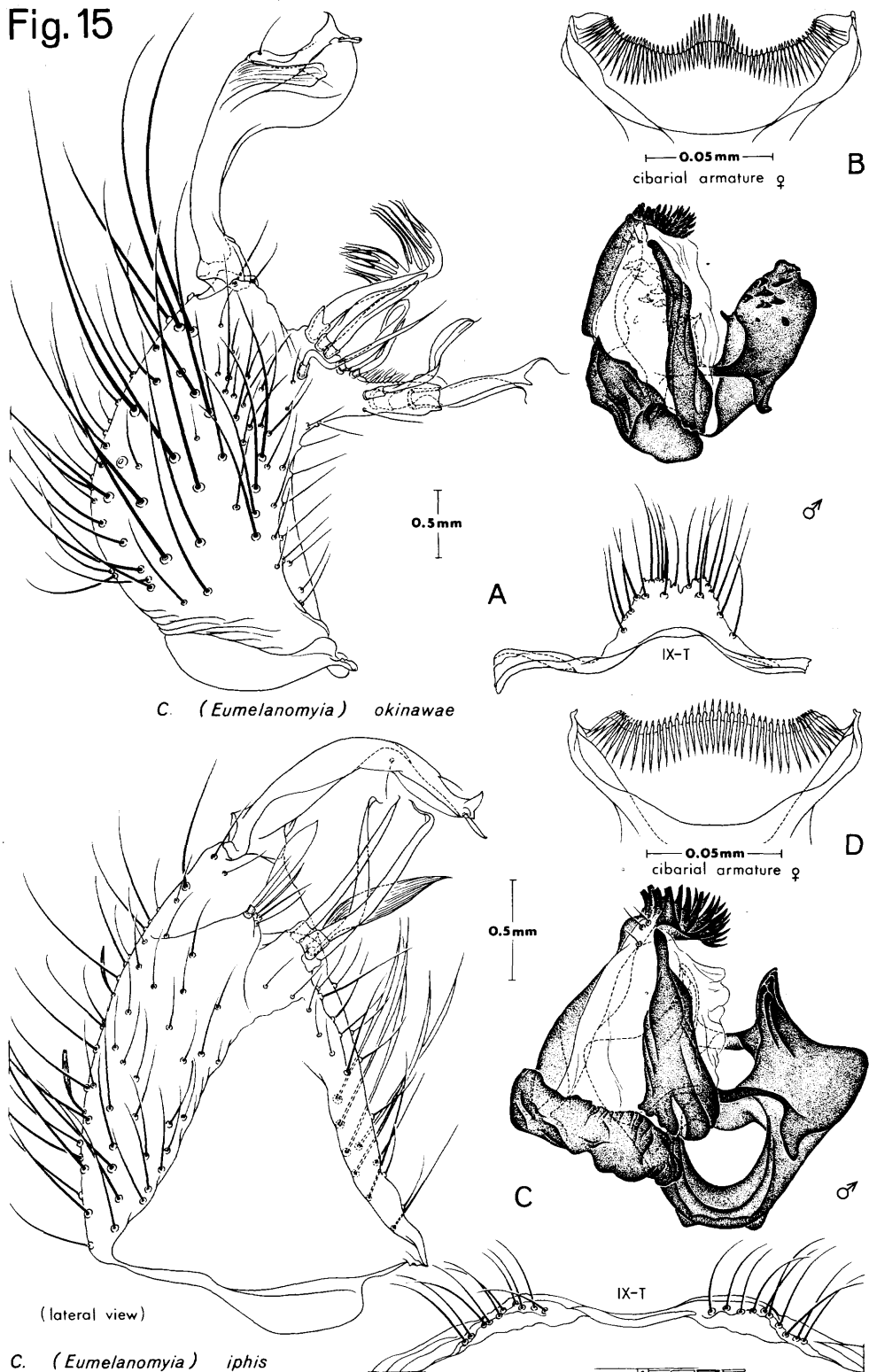
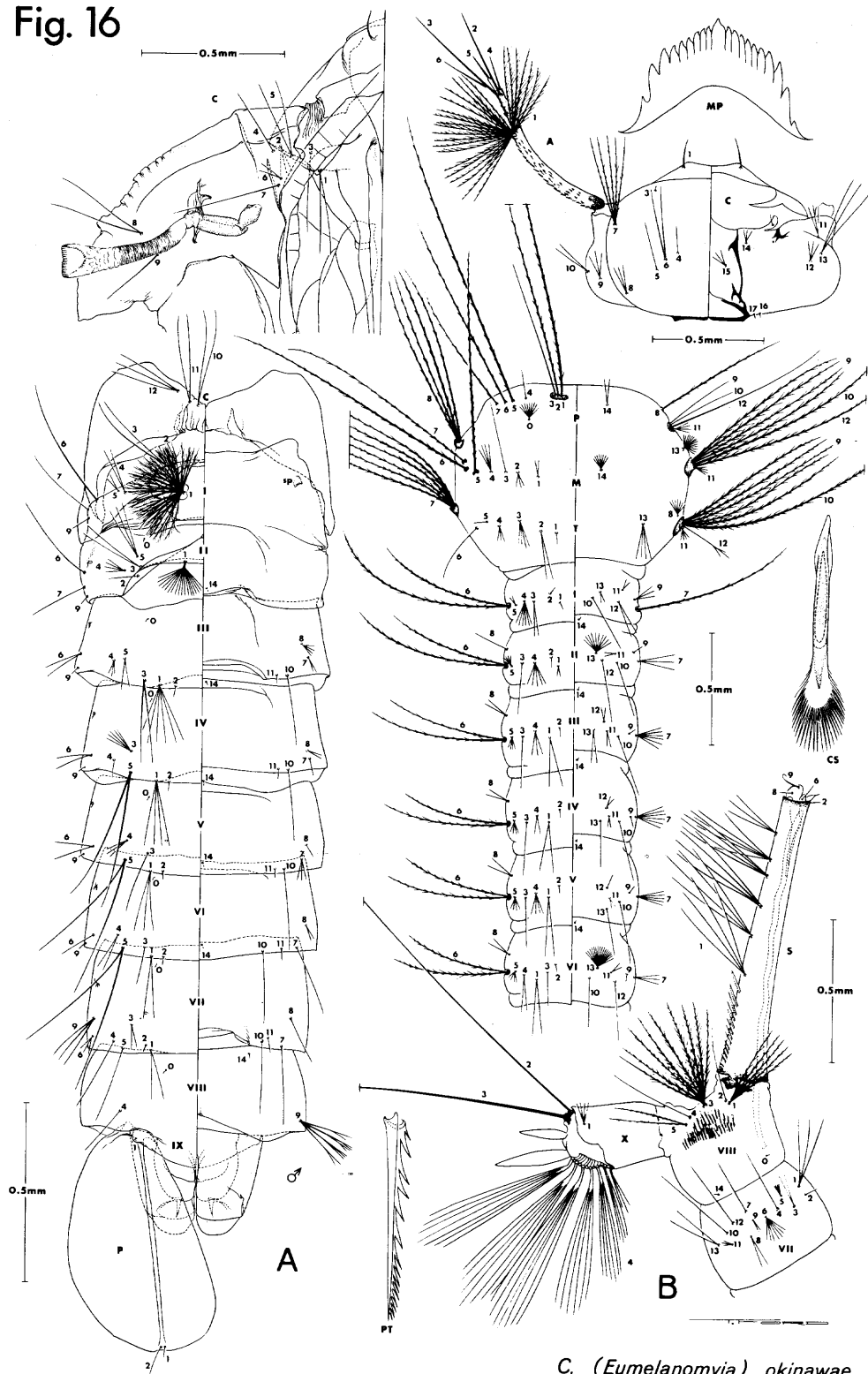
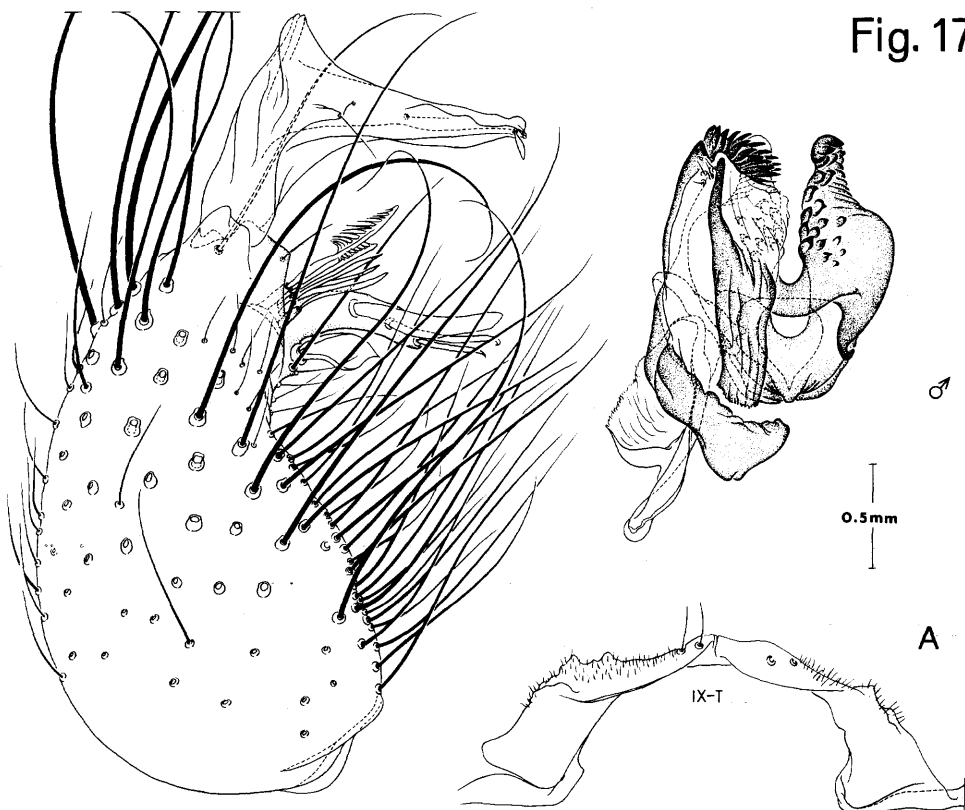


Fig. 16

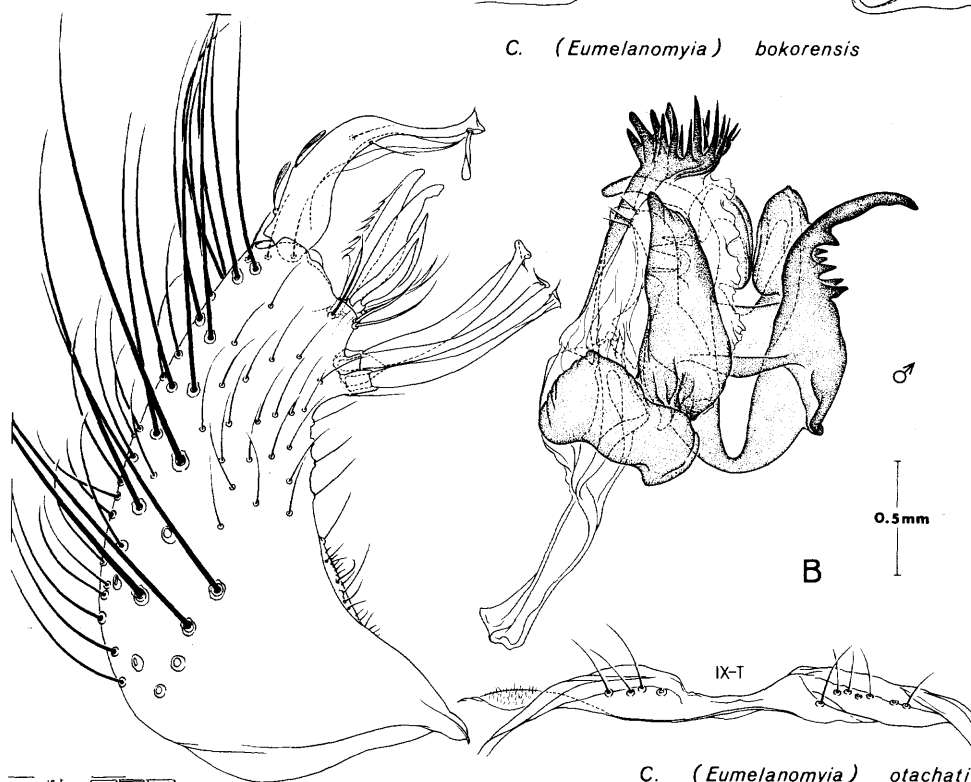


C. (Eumelanomyia) okinawae

Fig. 17



C. (Eumelanomyia) bokorensis



C. (Eumelanomyia) otachati

APPENDIX A

TABLE OF DISTRIBUTION AND HABITAT OF THE
ORIENTAL *EUMELANOMYIA*¹

SPECIES	STAGES				DISTRIBUTION	HABITAT
	♂	♀	P	L		
<i>RUBINOTUS-RIMA</i> GROUP						
1. <i>simplicicornis</i>	*	*	-	-	EAST MALAYSIA	unknown
2. <i>malayensis</i>	*	*	-	-	WEST MALAYSIA	unknown
<i>PROTOMELANO- CONION</i> GROUP						
3. <i>brevipalpis</i>	*	*	*	*	INDIA, BURMA, CEYLON, CHINA, TAIWAN, RYUKYU ISLANDS, THAILAND CAMBODIA, VIET- NAM, EAST & WEST MALAYSIA, INDO- NESIA, PHILIPPINES, NEW GUINEA, BIS- MARCK ARCHIPELA- GO	bamboo, treehole, artificial containers
4. <i>phangngae</i>	*	*	*	*	THAILAND	bamboo, tree- hole
<i>MOCHTHOGENES</i> GROUP						
5. <i>uncinatus</i>	*	*	-	-	PHILIPPINES	coconut shell?
6. <i>foliatus</i>	*	*	*	*	THAILAND, SOUTH VIETNAM, HONG- KONG, EAST & WEST MALAYSIA, ANDA- MAN ISLANDS, INDO- NESIA, PHILIPPINES	ground pool, rock pool
7. <i>latifoliatus</i>	*	*	*	*	PHILIPPINES	ground pool
8. <i>hinglungensis</i>	*	-	-	-	CHINA, THAILAND, CAMBODIA, PHILIP- PINES	unknown
9. <i>castrensis</i>	*	*	*	-	INDIA, CEYLON	unknown
10. <i>cataractarum</i>	*	*	-	-	PHILIPPINES, NEW BRITAIN (BISMARCK ARCHIPELAGO)	unknown

¹ * = stage or sex known
- = stage or sex unknown

APPENDIX A (Continued)

SPECIES	STAGES				DISTRIBUTION	HABITAT
	♂	♀	P	L		
11. <i>baisasi</i>	*	-	*	-	PHILIPPINES	axil of Colocasia sp., rock-pool
12. <i>malayi</i>	*	*	*	*	INDIA, BURMA, NEPAL, MAL-DIVE ISLAND, ANDAMAN ISLANDS, CHINA, HONGKONG, THAILAND, VIETNAM, EAST & WEST MALAYSIA, INDONESIA, NEW GUINEA	ground pool
13. <i>laureli</i>	*	*	*	*	PHILIPPINES	ground pool
14. <i>yeageri</i>	*	*	*	*	PHILIPPINES	ground pool, rock pool
15. <i>pluvialis</i>	*	*	-	-	INDIA	rock pool
16. <i>campilunati</i>	*	*	-	-	CEYLON	ground pool
17. <i>selai</i>	*	-	-	-	CAMBODIA, EAST MALAYSIA	ground pool
18. <i>khazani</i>	*	*	-	*	INDIA	treehole
19. <i>tenuipalpis</i>	*	*	*	*	INDIA, THAILAND	ground pool, foot print
20. <i>richei</i>	*	-	-	-	CAMBODIA	unknown
21. <i>hayashii</i>	*	*	*	*	JAPAN, KOREA, RYUKYU ISLANDS, TAIWAN ? USSR ?	ground pool
22. <i>hackeri</i>	*	*	-	-	WEST MALAYSIA	ground pool
23. <i>kiriensis</i>	*	*	*	-	THAILAND, CAMBODIA	ground pool
24. <i>okinawae</i>	*	*	*	*	RYUKYU ISLANDS, TAIWAN, PHILIPPINES	rock pool
25. <i>iphis</i>	*	*	-	-	INDIA	unknown
26. <i>bokorensis</i>	*	-	-	-	CAMBODIA	unknown
27. <i>otachati</i>	*	-	-	-	THAILAND, CAMBODIA	unknown
28. sp.	-	-	*	*	PHILIPPINES	rockhole, treehole

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